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Interactions of Dividends and Investment: A Test of
the John and Williams Signalling Equilibrium Model

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INTERACTIONS OF DIVIDENDS AND INVESTMENT: A TEST OF THE JOHN
AND WILLIAMS SIGNALLING EQUILIBRIUM MODEL

Abstract

The purpose of this paper is to analyze the effect of corporate growth and investment on the dividend decision of the firm. Based on a Signalling Equilibrium Model recently derived by John and Williams, two empirically testable error components models are formulated. Effects of growth opportunities are explicitly introduced in this model. The results indicate: for low growth firms the investment variable in both the dividend per share and the dividend payout equations are negative and significant and for high growth firms these variables are positive and significant. These results suggest that for high growth firms the desire to pay more dividends and hence signalling earning potential is not adversely effected by the investment decision, while for low growth firms the dividend decision is adversely effected by the investment decision because the signalling of earning potential is not necessary for low growth firms.

INTERACTIONS OF DIVIDEND AND INVESTMENT: A TEST OF SIGNALLING THEORY UNDER DIFFERENT GROWTH OPPORTUNITIES

Introduction

The interactions of investment policy and dividend policy have concerned Spies [36], Fama [14], Dhrymes and Kurz [11], Miller and Modigliani [31], Higgins [18], McCabe [29], McDonald, Jacquillant, and Mussenbaum [30], and Peterson and Benesh [33], among others. Two theories exist in the literature regarding the relationships between investment and dividend decisions. The first, based on the perfect capital market theorem, suggests that investment decisions and dividend decisions of firms are not related since, in a perfect capital market, optimal investment decisions by a firm are independent of how such decisions are financed. The second, based on the assumption of imperfect capital markets, proposes that they are negatively related since dividends and investments are competing uses of limited internal funds. Dhrymes and Kurz [11] and Fama [14] have developed simultaneous equation models to test these two extreme hypotheses and obtain entirely different empirical results.

By applying two-stage least squares (2SLS) and three-stage least squares (3SLS) to cross-sectional data for 181 individual firms, Dhrymes and Kurz [9] have found that investment decisions and dividend decisions of firms are negatively and significantly related. By applying OLS and 2SLS to time-series data for each of 298 firms, Fama [14] has found that dividend and investment decisions of firms are either not statistically related or positively related for most of the

firms studied. He has also found that 2SLS estimates do not generally perform better than OLS in terms of prediction errors and t-statistics. He suggests that there is no evidence requiring the treatment of dividend and investment decisions as interdependent endogenous variables in a simultaneous-equation model. When trying to sort out the reasons for the diverse findings of these two studies, we cannot be certain whether the differences are caused by differences in the underlying theory, or in the estimation methodologies. However, our conclusion is; a new look is required to gain insight into the problem by using a signalling equilibrium model derived by John and Williams (19).

In the next section a review of the literature is presented, followed by the development of an empirically testable model. Empirical results are presented and analyzed in the third section. In the final section, a brief summary and conclusion is given.

I. Review of the Existing Literature

Our approach to the problem is from two dimensions: theoretical and methodological. In this section we address the theoretical problems and in the next section the methodological ones. In Figure I an overview of the competing dividend theories is presented.

A serious problem which exists in the literature is the implicit assumption that all firms behave homogeneously regarding dividend and investment decisions; every study tries to prove the validity of one or the other theories for all of the firms concerned. With the heterogeneity of firms, it is doubtful that firms will behave in the same way with regard to investment and dividend decisions. One of

FIGURE I

OVERVIEW OF CORPORATE DIVIDEND THEORY

IRRELEVANCY THEORY

Dividends are irrelevant because:

1. Homemade dividends
2. Residual theory of dividends
3. Clientele effects

Literature:

Elton and Gruber [13]
Higgins [18]
Miller and Modigliani [31]
Pettit [34]

RELEVANCY THEORY

0% payout is best because:

1. Investment by the firm is better
2. Capital gains have preferential tax treatment
3. Retained earnings are cheaper than new equity issues

Literature:

Brennen [7]
Lee and Chang [22]
Litzenberger and Ramaswamy [25]

100% payout is best because:

1. Bird in the hand argument
2. Institutional demand
3. Valuation models

Literature:

Durand [12]
Gordon [16]
Graham and Dodd [17]

FIGURE I (continued)

OPTIMUM DIVIDEND THEORY

There exists an optimum dividend payout because:

1. Information effect on stock price
2. Signalling effect on stock price
3. Agency theory

Literature:

Bhattacharya [5, 6]
Dhrymes and Kurz [11]
Fama [14]
John and Williams [19]
McCabe [29]
Peterson and Benesh [33]
Ross [35]

STOCK REPURCHASE THEORY

Stock repurchase is preferable to dividends because:

1. Information on signalling
2. Leverage
3. Dividend tax avoidance
4. Bondholder expropriation
5. Wealth transfers among shareholders

Literature:

Dann [10]
Marsulis [27]
Vermaelen [37]

HISTORICAL DIVIDEND PAYMENT BEHAVIOR

Literature:

Brittain [8]
Fama and Babick [15]
Lee, Djarraya and Wei [23]
Lintner [24]

many factors which might affect a firm's behavior is growth. In investigating the relationship between stock price and dividends, Gordon [16] and Miller and Modigliani [31] argue that the growth of dividends is an important factor to consider. If the growth in dividends is related to the growth in earnings, assets, or any other measure of firm activity, then stratifying firms by a measure of growth seems to be one reasonable way of evaluating dividend differences among firms.

Two opposing arguments can be found which relate growth orientations of firms to their dividend/investment decisions. The first suggests that dividend and investment decisions might not be related for high growth firms, while they are negatively related for low growth firms. According to this theory, if a firm commits itself to rapid growth, a great amount of investment will be needed and internal funds alone are usually insufficient. In order to develop and maintain a good capital market relationship and signal future earnings potential so that external funds are more obtainable, the firm is likely to pay higher dividends than otherwise although the investment demand for the same source of funds is great (see Ross [35]). There is an interesting argument by Miller and Modigliani [31] that dividend disbursements convey information to the market on the future potential profitability of a firm. Bhattacharya [5, 6] uses a signalling-theory approach to explain firms' dividend-payment decisions. For high-growth firms investment and dividends are less likely to be negatively related. On the other hand, for firms with relatively little growth potential which need less outside funds, dividend and investment are

likely to be negatively related since they are competing uses of internal funds.

The second theory suggests, however, that dividend and investment decisions are also negatively related for high-growth firms. Since high growth adversely impacts the liquidity position of firms, low dividend payouts shall be associated with those firms (see, for example, Weston and Brigham [39]). In addition, high growth rates imply high profit potential, which in turn requires that earnings be retained rather than distributed to stockholders, whose investment alternatives might not offer higher returns. High-growth firms can also attract capital-gains oriented investors who are in high income brackets and are more interested in taking their income in the form of capital gain rather than as dividends, which are subjected to higher income tax rates. For high-growth firms, therefore, dividend and investment decisions should also be negatively related.

In trying to reconcile these theoretical differences, John and Williams [19] present a theoretical model of dividend behavior based on a signalling equilibrium. If the corporate demand for cash I and the individual demand for cash L exceed the firm's supply of cash C such that

$$C < L + I \quad (1)$$

then either the corporation must sell shares or the individual shareholder must sell his shares to a new investor to raise new funds. In either case, the sale of shares will result in a dilution for current shareowners. By signalling with larger dividends, the management can

increase the price per share and thereby reduce this dilution. For the shareholder retaining a fraction of the firm, the marginal benefit of reducing the dilution is greater for a more valuable firm than for a lower value firm. Thus, there exists a pricing function for a firm's stock which for high value firms offers an increase in value for high dividends. The reduction in the dilution more than offsets the increase in personal taxes for the shareholder. While for low value firms, small or low dividends are valued and if the personal tax effects exceed the reduction in dilution, a small or zero dividend is desirable.

If the corporate plus individual demand for cash is less than the firm's supply of cash

$$C > L + I \quad (2)$$

then it is optimal to pay no dividends.

If $L < C - I < 0$, then all new shares can be sold to the old shareholders with no dividends. And, if $0 < L < C - I$, then all shares sold by the shareholders can be repurchased by the firm.

The John and Williams model offers a plausible explanation for the divergent theories shown in Figure I. For the purpose of this paper all that is needed is acceptance of the fact that high growth firms have: (1) investment demands I such that $C < L + I$ is always true and (2) high value firms are high growth firms. And low growth firms have either: (1) investment demands I such that $C > L + I$ or (2) investment demands I such that $C < L + I$ and low growth firms are low value firms.

This argument allows us to hypothesize that firms with a lot of investment opportunities (high growth) will pay large dividends to maintain their market price. And firms with few investment opportunities (low growth) will adjust the dividend payment to fund the investments. This asymmetrical behavior encompasses both the theoretical and empirical work that has been done to date.

To our best knowledge, this segmented approach to investigating the effect of growth orientations on the dividend-investment decision has never been tested empirically or reported in the financial literature. The purpose of this study is to investigate empirically the behaviors of a group of high-growth and a group of low-growth firms with regard to dividend and investment decisions. The high-growth and low-growth firms will be formed into two separate groups with separate regression equations estimated. It is recognized in this paper that, in addition to growth orientation, many other factors may also affect decisions of a specific firm. It is thus impractical to try to develop a model capable of explaining different situations which lead to decisions of specific firms regarding dividend and investment. In this study, the effect of growth and dividend signalling on the average behavior of firms will be analyzed from results obtained from pooled cross-sectional and time-series data.¹

II. The Model

In this section, a model used in previous studies will first be introduced and commented upon briefly. Two alternative models for the study of relationships between dividend and investment decisions of firms will then be derived.

Among studies on dividend behaviors of firms, the partial adjustment model suggested by Lintner [24] has most often been used.² Suppose there are observations on N firms over T periods of time. The Lintner model can be written in terms of the following two equations:

$$D_{it}^* = \beta_1 P_{it} + \eta_{it} \quad (3A)$$

$$\Delta D_{it} = \gamma(D_{it}^* - D_{i,t-1}) \quad 0 < \gamma \leq 1 \quad (3B)$$

$$i = 1, 2, \dots, N$$

$$t = 1, 2, \dots, T$$

where D_{it} is the dividend of firm i in period t , P_{it} is the profit of the same firm in the same period, η is a disturbance term, D^* is the equilibrium (or desired) value of D .³ β_1 and γ are parameters to be estimated. The coefficient of adjustment γ should be greater than zero and less than or equal to one and β_1 is a positive fraction.

Combining equations (3A) and (3B), the following estimable equation can be obtained:

$$\Delta D_{it} = \gamma\beta_1 P_{it} - \gamma D_{i,t-1} + \epsilon_{it} \quad (4)$$

where $\epsilon_{it} = \gamma\eta_{it}$. To study possible effect of investment on dividend, changes in capital stock which includes new investment as well as replacement type investments, ΔK_{it} , can be added to equation (3A) with a coefficient α_2 as

$$D_{it}^* = \alpha_1 P_{it} + \alpha_2 \Delta K_{it} + \eta_{it} \quad (3A')$$

Equation (3A) defines the optimal dividends as the function of the current earnings and equation (3A') defines the optimal dividend as the function of both earnings and investment opportunity. If $\alpha_2 = 0$, then β_1 will equal α_1 , and equation (3A) and (3A') are equivalent. Hence equation (3A') is a generalized specification for equation (3A). Substituting equation (3A') into (3B) we obtain

$$\Delta D_{it} = \alpha_0 + \gamma\alpha_1 P_{it} + \gamma\alpha_2 \Delta K_{it} - \gamma D_{i,t-1} + \epsilon_{it} \quad (5)$$

in which $\gamma\alpha_2$ indicates the short-run effect of ΔK on ΔD and α_2 as the long-run effect. Due to contradictory theories regarding the relationship between investment and dividend decisions of firms as discussed in the preceding section, the sign of α_2 cannot be resolved a priori and can only be determined empirically. If α_2 is estimated to be negative and statistically significant, dividend and investment of firms are proved to be negatively related and hence the assumption of imperfect capital markets is supported. Otherwise, they are unrelated and hence the implication of the perfect capital market theorem cannot be rejected. Equation (5) is identical to one of the basic equations used by Fama [14] to derive an empirically testable model for the study of dividend and investment decisions. However, the basic assumptions used to derive the model are different. Fama uses Miller and Modigliani's [31] assumption of interdependency between D_{it} and ΔK_{it} to derive his empirically testable equation, whereas, we use the model derived by John and Williams [19].

The sources and uses of funds relationship of Miller and Modigliani [31] can be defined as:

$$D_{it} = P'_{it} - \Delta K'_{it} + F_{it} \quad (6)$$

where F_{it} is the amount of external financing; P'_{it} and $\Delta K'_{it}$ are the cash flows from operations and changes in the capital stock respectively. This equation implies that the dividends payments can be affected by cash flows, net investments and amount of external financing.⁴

The relationship between ΔK_{it} and F_{it} is generally used to determine whether internal financing or external financing is the major source of new investment. If F_{it} is equal to ΔK_{it} , then the investment decision will not affect the dividend decision. If F_{it} is smaller than ΔK_{it} , then the investment decision will have negative impact to the dividend payment.⁵ These arguments do not explicitly take into account the potential "information content" dividend-decision behavior as suggested by Miller and Modigliani [31] or the signalling behavior postulated by John and Williams [19]. If the managers use dividend changes to signal the potential future earnings of their firms, then the increase of new investments might also increase a firm's dividend payment. To accomplish this strategy, a manager can use more external sources of funds to finance their new investments. Hence the estimated α_2 can be used as an indicator of examining the trade off between the relative importance of dividend signalling and personal taxes on dividends. According to our interpretation of John and Williams, for high growth firms, the dividends signalling is generally more important than the personal tax considerations and the estimated α_2 will generally be positive. For

low growth firms, the dividend signalling is generally not as important as personal tax considerations and the estimated α_2 will generally be negative.

The specification of equation (5), however, might be biased against possible negative relationship between dividend and investment for a firm. If a firm enjoys greater profits in a year, it is likely that both dividends paid out and investment of the firm will be increased, and vice versa. Also because of inflation, ΔD , P and ΔK are even more likely to move in the same direction if nominal data are used. Due to multicollinearity between P and ΔK , the estimated parameters might also be subject to large sampling errors.

To avoid such potential specification problems, the model can be formulated in terms of the dividend payout ratio instead of the dollar amount of dividends. Rewriting equation (3A') in terms of the payout ratio gives:

$$\frac{D_{it}^*}{P_{it}} = \beta_0 + \beta_1 \frac{\Delta K_{it}}{P_{it}} + \mu_{it} \quad (7)$$

where $\mu_{it} = n_{it}/P_{it}$. This says that a firm's target dividend payout ratio is equal to a constant term plus a variable term which depends on the firm's investment during time t . According to John and Williams [19]:

Given sufficiently large demands for external funds
 $I - C + L$, firms with higher expected returns and
 thereby higher values X have higher payout ratio...

In effect as the firm has higher demands for investment we should expect the more valuable (high growth) firms to increase their payout ratios.

Following the adjustment argument of Lintner [25] we can rewrite equation (3B) in terms of the desired payout ration and the actual payout ratio:

$$\Delta\left(\frac{D_{it}}{P_{it}}\right) = \gamma' \left[\left(\frac{D_{it}}{P_{it}}\right)^* - \frac{D_{i,t-1}}{P_{i,t-1}} \right] \quad (8)$$

Note γ' is the partial adjustment coefficient for the payout ratio instead of the partial adjustment coefficient for dividends per share. By combining equations (7) and (8), the following estimable equation can be obtained.

$$\Delta\left(\frac{D_{it}}{P_{it}}\right) = \beta_0 \gamma' + \beta_1 \gamma' \frac{\Delta K_{it}}{P_{it}} - \gamma' \frac{D_{i,t-1}}{P_{i,t-1}} + \epsilon_{it} \quad (9)$$

In this payout ratio form both dividend and investment are normalized by earnings, hence, the specification of equation (9) is no longer biased against a possible negative relationship between dividend and investment. If a firm earns more profit in a year, both D_{it}/P_{it} and $\Delta K_{it}/P_{it}$ do not necessarily increase at the same time although both D_{it} and ΔK_{it} are likely to be greater. If a firm primarily depends on internal funds for investment, then as $\Delta K_{it}/P_{it}$ increases, D_{it}/P_{it} is likely to decrease, and vice versa. Hence these two variables of this firm are likely to be negatively related. On the other hand, if a firm raises the payout ratio or holds it constant in order to maintain a good capital market relationship for attracting outside funds for investment, D_{it}/P_{it} and $\Delta K_{it}/P_{it}$ of this firm might move in the same direction or show no relationship at all. In addition, since both dividend and investment are expressed as a ratio to profits, inflation can no longer produce spurious correlation between dependent and

explanatory variables. Equation (9) is the basic structure to be estimated in this study. According to this specification, $\beta_1\gamma'$ is the short-run effect of changes in investment ratio on the dividend payout ratio and β_1 is the long-run effect.

As mentioned in the first section, the firms covered in this study are highly heterogeneous. There are different factors which affect the dividend and investment decisions of firms. It is very difficult if not impossible, to specify a single model capable of reflecting different factors affecting the behaviors of all firms. If relevant variables are omitted from a regression equation, as is well known in econometrics, the estimates obtained are likely to be biased. The time-series of each firm is too short to allow the estimation of an equation for each firm with adequate variables and degrees of freedom. Desirable results, therefore, cannot be obtained if an equation is estimated for each firm. In this study, cross-sectional and time-series data are pooled in regression to overcome the problem of insufficient degrees of freedom. The error component model is used to take into account the effect of omitted variable on the estimated coefficients. Appendix A contains a discussion of the econometric procedure used for the empirical estimations.

III. Empirical Results

The data for this study is taken from the 1982 annual industrial file of the Compustat tapes.⁶ The tapes contain data for 20 years (1963-1982). Since data for 1982 are incomplete for most of the firms and data for the first two years are lost due to the need to take the

lags of the variables, the sample period of this study is 17 years (1965-1981). The variables in equation (9) are measured as

D_{it} = Common dividends declared on the common stock of company i in year t .

P = Net income less preferred dividend requirements, which is the net income available for common,

K = Net plant and equipment, which represents gross plant minus accumulated reserves for depreciation, depletion, amortization, etc.

The companies listed in the New York Stock Exchange and also in the S & P 400 Industrial Index are the data base of this study. However, those companies, which did not have complete data, did not have positive earnings, or did not pay out dividends in any one year during the sample period, are excluded from the sample. The actual sample includes 256 firms.⁷

Before engaging in regression analysis, all of the firms in the sample were ranked according to the average annual growth rate of total assets in the sample period and divided into three groups: the high-growth group (85 firms), the middle-growth group (86 firms) and the low-growth group (85 firms). The growth rate of total assets is used as the measure of growth, this measure can be a proxy for the growth in earnings. This is a fairly good proxy, i.e., growth in assets is approximately equal to growth in earnings (cash flow) if the rate of return earned on new investment is greater than what the market requires for assets of equivalent risk. In effect, the new investment is made in projects with a positive net present value. The mean values of payout ratio (D_i/P_i) and investment-earning ratio

$(\Delta K_i/P_i)$ are then calculated for each firm in the sample period. Growth rates and payout ratios for these groups are listed in Table I. Only the extreme groups were used in the remainder of the study, i.e., the middle group was omitted. As a preliminary study on the relationship between dividend and investment decisions of firms, the mean of payout ratio was regressed on the mean of investment-earning ratio for the groups of high-growth and low-growth firms. Regression results are presented in Table II. The table shows that the relationship between D_i/P_i and $\Delta K_i/P_i$ are strikingly different between the high-growth and low-growth groups of firms. For low-growth firms, D_i/P_i is negatively and significantly affected by $\Delta K_i/P_i$; and $\Delta K_i/P_i$ alone explains D_i/P_i by almost 50 percent. For high-growth firms, D_i/P_i and $\Delta K_i/P_i$ are positively and significantly related. However, \bar{R}^2 is only about 6 percent.⁸ Such preliminary results suggest that for low-growth firms dividend decisions and investment decisions are negatively related, but for high-growth firms they are not negatively related.

To further study the relationship between dividend and investment decisions of firms, the error component model discussed in Appendix A is applied to the data described above for both high-growth and low-growth firms, each regression containing 1445 observations (85 firms and 17 years). Estimated results are given in Table III. Those obtained from OLS and LSDV are also presented in the table for comparison.

Table IIIA presents the regression results for the payout ratio form of the model, equation (9) and Table IIIB presents the dollar per share form of the model, equation (5). All of the estimated coefficients are statistically significant at the 0.05 level and the

TABLE I. Growth Rates of Assets and
Payout Ratios by Group of Firms

		High Growth Firms	Middle Growth Firms	Low Growth Firms
Dividend Payout Ratio (mean value in the sample period)	Maximum	0.783	0.962	1.505
	Minimum	0.148	0.237	0.248
	Mean	0.447	0.527	0.595
	(standard error)	(0.115)	(0.115)	(0.115)
Growth rate of real Assets (mean percent- age annual growth)	Maximum	37.15	12.12	8.30
	Minimum	12.20	8.32	3.37
	Mean	16.33	9.96	6.57
	(Standard error)	(4.54)	(1.10)	(3.37)

TABLE II.

Empirical Relationships between the Average
Payout Ratio and the Average Investment-Earning
Ratio of Two Groups of Firms
(Dependent Variable = D_i/P_i)

	Constant	$\Delta K_i/P_i$	\bar{R}^2	D.W.	N
Low Growth Firms	0.597* (49.19)	-0.221* (-8.89)	0.488	1.79	85
High Growth Firms	0.434* (32.31)	0.023* (2.29)	0.059	1.74	85

NOTE: D_i/P_i is the mean of payout ratio and $\Delta K_i/P_i$ is the mean of investment-earnings ratio for i th firm in the sample period. Figures in parentheses are t ratios. The N is the number of firms in the group.

*Indicates that a coefficient is statistically significant at the 0.05 level.

TABLE III.

Estimated Results Obtained from
the Pooled Data

A. Payout Ratio $\Delta\left(\frac{D_{it}}{P_{it}}\right) = \beta_0\gamma + \beta_1\gamma' \frac{\Delta K_{it}}{P_{it}} - \gamma' \frac{D_{i,t-1}}{P_{i,t-1}} + \varepsilon_{it} \quad (9)$

Estimation Method	Constant	$\Delta K_{it}/P_{it}$	$D_{i,t-1}/P_{i,t-1}$	\bar{R}^2
Low Growth Firms				
OLS	0.570 (27.92)	-0.111 (-12.36)	-0.884 (-35.31)	0.480
LSDV	0.689 (5.31)	-0.108 (-11.84)	-0.965 (-36.92)	0.499
GLS	0.583 (19.86)	-0.111 (-12.42)	-0.904 (-36.04)	0.501
High Growth Firms				
OLS	0.314 (35.72)	0.051 (51.79)	-0.796 (-51.24)	0.792
LSDV	0.407 (9.50)	0.053 (62.93)	-0.906 (-65.28)	0.860
GLS	0.356 (17.70)	0.053 (63.01)	-0.891 (-64.95)	0.860

TABLE III (continued)

B. Dividend Per Share $\Delta D_{it} = \alpha_0 + \gamma\alpha_1 P_{it} + \gamma\alpha_2 \Delta K_{it} - \gamma D_{i,t-1} + \epsilon_{it}$ (5)

Estimation Method	Constant	P_{it}	ΔK_{it}	$D_{i,t-1}$	\bar{R}^2
Low Growth Firms					
OLS	-0.0076 (-3.07)	0.2755 (26.08)	-0.0318 (26.08)	-0.5778 (-34.34)	0.968
LSDV	-0.0124 (-0.81)	0.2828 (26.59)	-0.0268 (-2.56)	-0.5688 (-33.69)	0.967
GLS	-0.2041 (-1.10)	0.2723 (31.78)	-0.0501 (-5.17)	-0.6189 (-45.13)	0.967
High Growth Firms					
OLS	-0.0110 (-5.81)	0.0622 (13.22)	0.0137 (18.41)	-0.9766 (-83.39)	0.992
LSDV	-0.0147 (-7.49)	0.0721 (14.31)	0.0136 (7.40)	-0.9657 (-80.90)	0.992
GLS	-0.0141 (-3.85)	0.0673 (14.65)	0.0115 (6.56)	-0.9800 (-87.65)	0.992

NOTE: Both time and firm dummies were included when LSDV was used. The coefficients for the dummy variables are not presented here to save the space; they are available from the author. The figures in parentheses are t-ratios. There are 85 firms and 17 years of observations each for both high-growth and low-growth firms.

coefficient for both $D_{i,t-1}/P_{i,t-1}$ and $D_{i,t-1}$ has the correct sign regardless of the estimation methods or the groups of firms considered.

The coefficients associated with both $D_{i,t-1}$ and $D_{i,t-1}/P_{i,t-1}$ are partial adjustment coefficients. Partial adjustments obtained from equation (5) for low growth firms are lower than those from equation (9). However, partial adjustment coefficients for equation (5) for high growth firms are similar to those obtained from equation (9). These differences can be explained as follows.

By substituting equation (7) into (3B), we obtain

$$D_{it} - D_{i,t-1} = \gamma[\beta_0 + \beta_1 \frac{\Delta K_{it}}{P_{it}} - D_{i,t-1}] + \text{error} \quad (10)$$

Solving this for change in the dividend payout ratio in period t yields:

$$\Delta(\frac{D_{it}}{P_{it}}) = \gamma\beta_0 + \gamma\beta_1 \frac{\Delta K_{it}}{P_{it}} - [\frac{D_{i,t-1}}{P_{i,t-1}} - (1-\gamma) \frac{D_{i,t-1}}{P_{i,t}}] \quad (11)$$

Equation (11) is directly derived from equation (5) by normalization. It will reduce to equation (9) if $\frac{D_{i,t-1}}{P_{i,t-1}} = \frac{D_{i,t-1}}{P_{i,t}}$. In other words, if $P_{i,t-1} = P_{i,t}$, then partial adjustment coefficient for dividend per share payments is equal to that of the partial adjustment coefficient for the payout ratio.

In comparing the adjustment coefficient (γ') for the payout ratio with γ for the dividend per share, we see that the estimated coefficients for the payout ratio are not significantly different from minus one for both the high and low growth firms. This indicates that the management of both types of firms adjust the firm's payout ratio quite quickly to some target payout ratio. The values of γ coef-

ficient in the dividend per share model present a slightly different behavior. For low growth firms the adjustment of dividends per share to a target level is slower than for the high growth firms whose coefficient of adjustment is not significantly different from one.

Estimated results for the same group of firms are not sensitive to the estimation methods used. Generally, the estimates obtained from GLS and LSDV have slightly smaller standard errors than those obtained from OLS. A comparison of the coefficients of the investment variable for the two groups of firms again discloses the striking difference in behaviors between low-growth and high-growth firms regarding dividend and investment decisions. The estimated coefficient of $\Delta K_{it}/P_{it}$ for the low-growth firms is negative and significant while that for high-growth firms is positive and significant. Such empirical results conform with the hypothesis that for low-growth firms dividend and investment decisions are negatively related, but they are not negatively related for high-growth firms.

One of the two theories explained in the first section, that dividend and investment decisions of high-growth firms should be negatively related, is thus rejected. The results suggest that high-growth firms are not likely to reduce the payout ratio in order to increase investment since such action might detract from their ability to attract external funds. For low-growth firms, dividend and investment decisions are negatively related since they are competing uses of funds. The above results differ with the finding of Fama [14], that dividend and investment decisions of firms are not related.

The finding of Dhrymes and Kurz [11] that the two decisions are negatively related, is not fully supported. The results of this study indicate that the relationship between this investment and dividend decision depends upon the investment opportunities available to the individual firm.

IV. Summary and Conclusion

In the preceding sections, theories on the effect of growth orientation on dividend-investment decisions of firms has been introduced. A new theoretical model for the study of relationship between dividend and investment decisions of firms has been presented. The model is based on the partial adjustment model and the signalling-theory approach. The payout ratio is used in the Lintner adjustment model framework so that spurious correlation and multicollinearity problems can be avoided or reduced. Statistical methods for the estimation of equations from pooled cross-sectional and time-series data have been introduced. Empirical results have shown that for low-growth firms the mean values of payout ratios over the sample period are negatively and significantly related to the mean values of investment-earning ratios. For high-growth firms, they are positively and significantly related. Results obtained from the pooled data also revealed a positive and significant relationship between dividend decisions and investment decisions of high-growth firms, and a negative and significant relationship between the two decisions of low-growth firms. The results suggest therefore that for high-growth firms the desire to pay reasonable dividends and hence signalling earning potential causes dividend decisions of such firms not to be adversely affected by

investment decisions, while for low growth firms investment decisions do adversely affect dividend decisions.

Theoretically, this paper has used the John and Williams [19] signalling equilibrium approach to derive an indicator for explaining the generalized interaction relationship between the dividend decision and investment decisions. In light of the myriad of previous studies which have reached varied conclusions, this research provides an explanation, which is empirically supported, which can be used to reconcile the apparent differences concerning the relationship between dividends and investments.

Appendix A

According to the model suggested by Balestra and Nerlove [2] and Wallace and Hussain [38], the error term in Equation (9) can be written in terms of the sum of three components: $\varepsilon_i = w_i + v_t + u_{it}$, where w_i represents the time invariant, unobserved firm effects, v_t represents firm invariant, unobserved time effects on the dividend payout ratio of a firm,⁹ and u_{it} represents the remaining effects which are assumed to vary in both cross-section and time dimensions.

One way to estimate the parameters in equation (9) is to treat w_i and v_t as constants. Under the assumption that u_{it} are independent with zero means and constant variances, least squares regression of $\Delta(D_{it}/P_{it})$ on $\Delta K_{it}/P_{it}$ and $D_{i,t-1}/P_{i,t-1}$ and firm and time dummies can be used to estimate the parameters. This approach is known as the least squares with dummy variable technique (LSDV). As indicated by Maddala [26], the use of the dummy variable technique may eliminate a major portion of the variation among both the dependent and explanatory variables if the between firm and between time-period variation is large. In addition, in some cases, there is also a loss of a substantial number of degrees of freedom. Hence LSDV may not be an efficient method of estimation.

Another approach to deal with equation (9) is to treat the error components w_i and v_t as random.¹⁰ In this case, instead of N w 's and T v 's, we estimate only the means and the variances of the disturbances of w 's and v 's. This is known as the error component model, wherein the regression error is assumed to be composed of three components--one associated with time, another with firms, and the third variable both

in the time and cross-section dimensions. The assumptions on the components of the error term are that they are independent random variables with constant variances. Without loss of generality, it is also assumed that they have zero means. To estimate the parameters in (9), generalized least squares (GLS) can be used. In matrix notation, equation (9) can be written as:

$$Y = X\beta + \varepsilon \quad (A1)$$

where Y is an $NT \times 1$ vector, the elements of which are the observations on $\Delta(D_{it}/P_{it})$ for N firms in T periods, X is an $NT \times 3$ matrix with one's in the first column and observations on $(\Delta K_{it}/P_{it})$ and $(D_{i,t-1}/P_{i,t-1})$ in the second column. ε is an $NT \times 1$ vector containing the error terms. Under the assumptions on the error components, the variance-covariance matrix of the disturbance terms ε_{it} is the following $NT \times NT$ matrix:

$$E(\varepsilon\varepsilon') = \Omega = \begin{bmatrix} \sigma_w^2 A_T & \sigma_v^2 I_T & \dots & \sigma_v^2 I_T \\ \sigma_v^2 I_T & \sigma_w^2 A_T & \dots & \sigma_v^2 I_T \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ \sigma_v^2 I_T & \sigma_v^2 I_T & \dots & \sigma_w^2 A_T \end{bmatrix} \quad (A2)$$

where I_T is a $(T \times T)$ identity matrix and A_T is a $(T \times T)$ matrix defined as:

$$A_T = \begin{bmatrix} \frac{\sigma_w^2}{\sigma^2} & 1 & \dots & 1 \\ 1 & \frac{\sigma_v^2}{\sigma^2} & \dots & 1 \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ 1 & 1 & \dots & \frac{\sigma_u^2}{\sigma^2} \end{bmatrix} \quad (A3)$$

in which σ_w^2 is the variance of w_i , σ_v^2 is the variance of v_t , σ_u^2 is variance of u_{it} , and $\sigma^2 = \sigma_w^2 + \sigma_v^2 + \sigma_u^2$. Given equation (A2), it is well known that the generalized least squares estimates of β , if σ_w^2 , σ_v^2 , and σ_u^2 are known, is

$$\hat{\beta} = (X' \Omega^{-1} X)^{-1} (X' \Omega^{-1} Y) \quad (A4)$$

with variance-covariance matrix

$$\text{Var} (\hat{\beta}) = (X' \Omega^{-1} X)^{-1} \quad (A5)$$

where X' is the transpose of matrix X , GLS estimates may be more efficient than LSDV or OLS estimates because they enable us to extract some information about the regression parameters from the between group and between time-period variations. In finite samples, Nerlove [31] has also found that it produces little bias.

In actuality σ_w^2 , σ_v^2 and σ_u^2 are usually unknown, but they can be estimated by the analysis of covariance techniques as follows (see, for example, Amemiya [1]):

$$\hat{\sigma}_u^2 = \frac{1}{(N-1)(T-1)} \sum_{i=1}^N \sum_{t=1}^T \left[e_{it} - \frac{1}{T} \sum_{t=1}^T e_{it} - \frac{1}{N} \sum_{i=1}^N e_{it} \right]^2 \quad (A6)$$

$$\hat{\sigma}_w^2 = \frac{1}{T} \left[\frac{1}{(N-1)T} \sum_{i=1}^N \left(\sum_{t=1}^T e_{it} \right)^2 - \hat{\sigma}_u^2 \right] \quad (A7)$$

$$\hat{\sigma}_v^2 = \frac{1}{N} \left[\frac{1}{N(T-1)} \sum_{t=1}^T \left(\sum_{i=1}^N e_{it} \right)^2 - \hat{\sigma}_u^2 \right] \quad (A8)$$

where e_{it} represents residuals obtained by applying the least squares method to the pooled data, assuming that w_i and v_t are constants to be estimated rather than random variables.

If σ_w^2 and σ_v^2 are estimated to equal zero, then Ω in (A2) is a $NT \times NT$ identifying matrix and hence equations (A3) and (A4) are the same as the OLS estimators. On the other hand, if the estimate of σ_w^2/σ^2 approaches one and $\hat{\sigma}_v^2$ approaches zero, equations (A3) and (A4) are equivalent to LSDV with firm dummies, if $\hat{\sigma}_v^2/\sigma^2$ approaches one and $\hat{\sigma}_w^2$ approaches zero, they are equivalent to LSDV with time dummies. Hence in applying GLS rather than OLS or LSDV, the existence of other time or firm effects can be determined by the sample rather than

assumed and the relative weights given to between and within firm and time-period variations for the estimation of the parameters are determined by the data. In OLS it is assumed that the between and within variations are just added up; in LSDV the between variation is completely ignored. (See Maddala [26], pp. 341-344).

FOOTNOTES

¹Previous research uses either cross-sectional or time-series data, we use pooled cross-sectional and time-series data to improve the precision of our empirical results.

²See Fama [14], Brittain [8], Fama and Babiak [15], Mayer and Kuh [28], Dhrymes and Kurz [11], and others.

³These variables are the same as those used in Fama [14]. They will be defined more precisely in Section III.

⁴Yosef and Lev [4] investigate the impact of inflation on the earnings and dividend relationship. They conclude that the various price adjustments made to reported earnings following FASB - No. 33 (Financial Reporting and Changing Prices) do not convey useful information about firms' dividend decisions. Hence conventionally reported historical cost earnings remain the best measure to account for dividend changes. Therefore the differences between accounting earnings and a cash flow approach seem to have little affect on the dividend and investment analysis.

⁵If both profits and external financing are held fixed then the sources and uses constraint of equation (6) forces investment and dividends to be negatively related. This is only a required sources and uses of funds relationship. However, our study investigates an economic relationship instead of a required relationship between dividends and investment. This study investigates whether actual investment is changed by dividend policy, i.e., their economic relationship.

⁶The Compustat tapes are documented in the Compustat Manual, supplied by Standard & Poor's Compustat Services, Inc., 7400 S. Alton Court, Englewood, Colorado 80112.

⁷A list of these firms is available from the authors.

⁸To investigate the effect of high payout and low payout in capital asset pricing, Bar-Yosef and Kolodny [3] and Lee and Chang [22] have used the same method to reduce (or eliminate) the classification errors. We use a similar method to perform our empirical studies.

⁹The firm effect refers to the effect of factors affecting the behavior of an individual firm; it is constant over time. The time effect refers to the economic condition of particular time point; it varies over time.

¹⁰For studies of this sort see, for example, Balestra and Nerlove [2], Wallace and Hussain [38], Maddala [26], and Chang and Lee [9].

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