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Residual Theory, Partial Adjustment and Information Content on
Dividend Payments Decisions: An Integration and Extension

Mohamed Djarraya
Cheng F. Lee

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Residual Theory, Partial Adjustment and Information Content
on Dividend Payments Decisions: An Integration and Extension

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Abstract

Based upon the practical decision process of managers, finance theory and modern econometric methods, a generalized dividend payments behavior model is derived and analyzed. It is analytically shown that the residual theory of dividends, a partial adjustment model and information content model are all special cases of the generalized model derived in this paper. In terms of eighty industrial firms' quarterly earnings and dividends data, Marquardt's non-linear regression method is used to estimate the parameters of the generalized model. It is shown that the generalized dividends behavior model can effectively identify individual firm's dividend decision behavior. It is not unreasonable to conclude that this study has successfully developed a new dividend decision model for theoretical and theoretical dividend decision in financial management.

Introduction

Dividend policy is one of the three most important policy decisions in financial management. Therefore, both financial managers and security analysts are generally concerned with the individual firm's dividend payments decision. There exist four possible reasons for us to investigate dividend payments behavior of a firm, i.e., (i) dividend policy is one of the essential factors in determining the market value of a firm, (ii) dividend decisions will generally affect the investment and financing decision of the firm, (iii) dividends might be used by investors as a basis for forecasting earnings, and (iv) economists might use the information related to corporate dividend policy to predict aggregated corporate savings.

Residual theory of dividends, partial adjustment and information content are three important theories for explaining individual firm's dividend payment behavior. Higgins (1972) has used the "residual theory of dividends" to explain a firm's dividend payments; Lintner (1956), Fama and Babick (1968) and others have used the "partial adjustment" hypothesis to explain a firm's dividends payment behavior; the "information content" hypothesis has been empirically tested by Pettit (1972, 76), Laub (1976) and Watts (1973). Ang (1975) has used the spectrum analysis technique to determine if a firm's short-run dividend payment behavior is in terms of "partial adjustment" or "information content" hypothesis. However, Professor Ang did not use a potentially more powerful econometric method to identify a firm's long-term dividend payment behavior.

The main purpose of this paper is to derive a generalized dividend behavior model and to empirically determine if a firm's dividend payment behavior follows a residual theory, a partial adjustment, an information content or a generalized behavior model. Data from 80 industrial firms are used in the empirical study. In the second section the alternative models used to describe the dividend payment behavior will be defined and integrated to obtain a generalized model. In the third section the estimation procedure used to estimate the generalized dividends behavior model will be explored. In the fourth section data from 80 sample firms are used to do the empirical studies. Finally results of this study are summarized.

II. Model Specification and Derivation

Based upon the partial adjustment model and the adaptive expectation model, the generalized model will be derived for identifying possible alternative dividend payments behavior hypotheses.

IIA. Partial adjustment model

The dividend behavior of twenty eight well-known companies was investigated in detail by Lintner (1956). He concluded that most dividend decisions of a firm can be explained in terms of the following two equations:

$$D_t^* = rE_t \quad (1)$$

$$D_t - D_{t-1} = \alpha + \gamma(D_t^* - D_{t-1}) + u_t \quad (2)$$

The "desired" dividend payment D_t^* is determined by the net income E_t of current period and the target payout ratio r . It is also assumed that

the level of dividend payments will move only partially from the starting position D_{t-1} to the desired position D_t^* when net income E_t increases to a new level. The move depends on the confidence of management in maintaining the new higher level of dividends. Thus the change of dividends between time t and time $t-1$ would be equal to $\gamma(D_t^* - D_{t-1})$ instead of $(D_t^* - D_{t-1})$. The parameter γ is the speed of adjustment coefficient, $(1 - \gamma)$ is sometimes interpreted as the safety factor for not adjusting to the desired level based on current net income. The constant term α in equation (2) was added by Lintner to test whether managers have greater reluctance to cut dividends than to raise them. This constant is postulated to be positive. Therefore, the firm will not cut its dividend payments unless $\delta(D_t^* - D_{t-1})$ is less than the constant term. Finally, u_t is the error term.

Substituting (1) and (2) yields

$$D_t - D_{t-1} = \alpha + r\gamma E_t - \gamma D_{t-1} + u_t \quad (3)$$

The Lintner model as indicated in (3) has performed well relative to other models in terms of aggregate data by Brittain (1966) and in terms of individual firms by Fama and Babiak (1968). An obvious difficulty in using the Lintner model is that it is not plausible to assume the desired dividend payment depends only on the current value of net income. If the net income of a firm changes from period to period, it might not be sensible to make important decision solely on the current values of E_t . The study of Harkins and Walsh (1971), which was made possible through the cooperation of 166 members of the Board's panel of senior financial executives, shows that these executives are well aware of this

problem. In fact, expectations of net incomes are considered as a very important factor for dividend decisions.

IIB. Adaptive expectation model

The partial adjustment model is not the only behavioral model of dividend payments. The adaptive expectation model is an alternative behavioral model for deriving and explaining equation (3). In this case, current dividends are assumed to be linearly related to expected value of net incomes rather than to current net income. This can be expressed as follows:

$$D_t = rE_t^* + u_t \quad (4)$$

where D_t and E_t^* and r are the current period dividends, the expected long run income and target payout ratio respectively and u_t is a random variable with zero mean and constant variance.

The adaptive expectation model can be viewed as a specification of Modigliani and Miller's (1961) "informational content of dividends" hypothesis.

Solomon (1963), Laub (1976), and Pettit (1972, 1976) have shown that dividend payments convey information about future earnings prospects and that a change in dividends is a result of a change in the expectations of long run expected income.

Since expected incomes are not an observable variable, equation (4) is not observable by some assumptions about how expectations are formed. Nerlove (1958) and Ball and Watts (1972) have assumed that

$$E_t^* - E_{t-1}^* = \delta(E_t - E_{t-1}^*) \quad (5)$$

or equivalently

$$E_t^* = \delta E_t + (1 - \delta)E_{t-1}^* \quad (5a)$$

where δ , the coefficient of expectations, is the proportion of the expectational error taken to be permanent rather than transitory [see Waud (1968)]. Expectations are updated each period by a fraction of the discrepancy between current observed income and the previous expected income. In other words, the expected or permanent value of E_t at time t is represented by a weighed average of the current income and the income expected in the preceding period. Such a formation of expectations is based on the idea that current expectations are derived by modifying previous expectations in the light of the current income. Therefore, dividends are considered to contain some information about expected incomes and that expectations are updated period by period. Equations (4) and (5) include Modigliani and Miller's interpretation of the dividends decision.

Repeatedly substitute the values of E_{t-1}^* , E_{t-2}^* , ..., and E_0^* into the right hand side of equation (5a) we have

$$E_t^* = \delta[E_t + (1 - \delta)E_{t-1} + (1 - \delta)^2 E_{t-2} + \dots + (1 - \delta)^t E_0] \quad (5b)$$

Substituting (5b) into equation (4) yields

$$D_t = r\delta[E_t + (1 - \delta)E_{t-1} + \dots + (1 - \delta)^t E_0] + u_t \quad (6)$$

one way to reduce the number of the explanatory variables to a manageable degree is to use the "Koyck transformation" [see Koyck (1954)]. First, lag equation (6) by one period and multiply both sides by $(1 - \delta)$. The resulting equation is then substituted from equation (6).

$$D_t - D_{t-1} = r\delta E_t - \delta D_{t-1} + u_t + -(1 - \delta)u_{t-1} \quad (7)$$

Equation (7) is an adaptive expectation model similar to Lintner's partial adjustment model as indicated in equation (3). The only difference between equation (3) and equation (7) is the specification of the disturbance term and the constant α . Consequently, two different rationales are used to reach the same dividend equation.

Although the explanatory variables are the same, the nature of the adjustment process should be recognized to differentiate between the interpretation of the coefficients. The γ in equation (3) is the speed of adjustment in the partial adjustment model and the δ in equation (7) is the profit expectations coefficient in the adaptive expectation model.

The adaptive expectation model can, in turn, be criticized for the assumption that current dividend D_t is adjusted immediately to the desired dividend payment D_t^* . Actually, it is assumed that D_t^* is subject only to the discrepancy caused by a random disturbance u_t . Therefore, a more general model embodying the conceptual components of both models should be used.

Although Brittain (1966) has recognized both alternatives mentioned above, he didn't test the proper rationale of the dividend behavior. He put more emphasis and concern on the determinants of the firm's payout ratio than on the intertemporal change of dividends as mentioned earlier.

Ang (1975) used spectral analysis to identify the difference between the two alternative hypotheses in terms of quarterly data of 20 industries associated with FTC-SEC quarterly reports of manufacturing corporations. Ang has argued that his empirical results has indicated the informational content hypothesis can be used to explain the short

run dividend behavior and the partial adjustment hypothesis can be used to explain the long-run dividend behavior. Nevertheless, both hypothesis are not supported by the empirical results in the intermediate run.

IIC. A generalized model

It will be shown that both informational content and partial adjustment hypotheses can be identified easily after intergrating these two hypotheses within a more generalized model. Ang (1975) has argued that is often difficult to distinguish these two alternative hypotheses in terms of regression models as indicated in (3) and (7). It will be shown how it is possible to distinguish between these hypotheses after estimating the coefficients of the generalized model by a nonlinear regression method.

Following Waud (1966), it is possible to embody the conceptual ingredients of both rationales in a more general specification. The desired value of dividends is defined as a linear function of long run expected incomes such as

$$D_t^* = rE_t^* \quad (8)$$

In equation (8), D_t^* and E_t^* are not observable. Therefore, they should be defined in terms of equations (2) and (5) as

$$D_t - D_{t-1} = \alpha + \gamma(D_t^* - D_{t-1}^*) + u_t$$

$$E_t^* - E_{t-1}^* = \delta(E_t - E_{t-1})$$

By combining equations (2), (5a), (5b) and (8), we then get

$$D_t = \alpha + \gamma r \delta [E_t + (1 - \delta)E_{t-1} + (1 - \delta)^2 E_{t-2} + \dots \quad (9)$$

$$\dots + (1 - \delta)^t E_0] + (1 - \gamma)D_{t-1} + u_t$$

Equation (9) can be simplified by using the Koyck transformation so that

$$D_t - D_{t-1} = \alpha \delta + (1 - \gamma - \delta)D_{t-1} - (1 - \delta)(1 - \gamma)D_{t-2} \quad (10)$$

$$+ r\gamma\delta E_t - (1 - \delta)u_{t-1} + u_t$$

In equations (10), the target payout ratio r is sometimes called long run elasticity and the $r\gamma\delta$ the coefficient of E_t is called short run elasticity [Doran and Griffiths (1978)].

The null hypotheses to be tested can be stated as follows:

- a) If the coefficient of expectations δ is equal to one, the generalized model as expressed by (10) reduces to a pure partial adjustment model as indicated in equation (3).
- b) If the speed of adjustment coefficient γ is equal to one and the intercept α is equal to zero, the model reduces to an adaptive expectation model as indicated in equation (7).
- c) If α is equal to zero and both parameters γ and δ are equal to one, equation (10) reduces to a simple regression model where current dividend is a function of current earnings.
- d) If r and α are not significantly different than zero but γ and δ are equal to one, the model reduces to

$$D_t = u_t \quad (11)$$

which means that dividend policy is a residual decision and it implies that dividends are irrelevant.

e) If r is not significantly different than zero, the profit expectations coefficient and the speed of adjustment coefficient are not significantly different than one; the generalized model reduces to

$$D_t = \alpha + u_t \quad (12)$$

This kind of behavior is explained by Higgins (1972). He showed that the residual theory of dividends cannot be rejected even if the change in dividend payments is not random. In fact, companies can smooth out actual payments of dividends by saving some funds in surplus years in anticipating of deficit one. This smoothness can be explained by the significance of the coefficient α in equation (12).

f) Furthermore, if all the coefficients of equation (10) are significantly different than zero, and the speed of adjustment and the adaptive expectation coefficients are both different than one; the two predominant hypotheses will be rejected and the generalized model will be the correct specification of the dividend behavior.

Therefore, equation (10) is a generalized model that incorporates all the important dividend policies existing in the financial literature. Those who use Lintner model have therefore implicitly assumed that expectations are formed statically or have failed to specify how they are formed. Those who use the informational content model, implicitly assume γ is equal to one, which means that dividend payments are assumed to adjust to any change in the expected level of incomes instantaneously. Therefore, the conservative bias against large revision of dividend payments is implicitly assumed to be non-existent. Waud (1966) has investigated the possible bias associated with the estimates of the regression

coefficients of different models as those expressed in (3), (7) and concluded that equation (10) instead of equation (3) and (7) should be used to do empirical studies.

The disturbance term for equation (10) is defined as

$$u_t = \rho u_{t-1} + v_t \quad (13)$$

where v_t is normally independently distributed and ρ is an auto-correlation parameter.

III. Empirical Results

There exist two alternative methods for estimating the parameters as indicated in equation (10), i.e., the ordinary least squares (OLS) method and the maximum likelihood (ML) method. Djarraya (1980) has shown that the OLS method cannot be used to distinguish between γ and δ . Doran and Griffiths (1978) have shown that the OLS estimators of γ and δ are inconsistent. Therefore, ML method is used to do the empirical study.

Marquardt's (1963) non-linear least squares regression method as discussed in Djarraya (1980) was used to estimate the dividend behavior parameters of equation (10) for 80 industrial firms.

It would be assumed in this study that net earnings as reported in the financial statements reflect the true economic income of the firm. Furthermore, net earnings per share and dividend per share will be used in this study instead of total earnings and dividends distributed as it is the case in most behavioral models of dividend policy.

These earnings will not include extraordinary items as flood or fires losses, profit or loss on repurchase of debentures, on sale of

assets, investments, securities, etc. In addition these earnings are reported by the company after the effect of conversion of convertible preferred, convertible debentures and options and warrants which have been identified as common stock equivalents.

Dividend per share is defined in this study as the cash dividends per share paid during a considered period. Earnings per share and dividend per share are adjusted for all stock splits and stock dividends that occurred during the period.

The source of data for this study is obtained from "The compustat tapes." Among the files in these tapes is the "Industrial file" which contains quarterly financial data for 40 variables for more than 2000 companies. The data is contained in two different tapes, i.e., 1) A historical tape which covers the period first quarter 1962 to fourth quarter 1971, and 2) A more recent tape which covers the period first quarter 1970 to fourth quarter 1978. However, data are not available for all firms for the entire period, and the fiscal year ends in different months of the year depending on each company. Therefore, the sample was restricted to those firms which met the following three requirements.

1) each company must have the following three variables needed for this study: dividends paid per share, earnings per share-excluding extraordinary items, and an adjustment factor (cumulative). The availability of the above three variables must be for the full period.

2) The fiscal years ends on December.

3) Utility companies (i.e., electric services, natural gas transmission, natural gas distribution), financial companies (i.e., banks,

savings and loan associations, insurance companies) are eliminated. The last requirement restricts the sample to companies that are not regulated like utility companies and non financial companies. 238 firms from the historical tape and 889 firms from the recent tape met the three requirements. Since it would be costly and time consuming to run non linear regression for the 238 total samples, a random sample of 80 companies is selected among the companies that have data for the full sixty-eight quarters.¹

IIIA. Analysis of the results when the data is seasonally unadjusted

Table 1 summarizes the cross-sectional distributions of parameters estimates obtained when Marquardt's non linear least squares regression was used to estimate the coefficients of equation (10) for each of the eighty firms in the total sample. In this preliminary estimation, the data is seasonally unadjusted and the disturbance terms (u_t^i s) are assumed to be serially independent. In this table, the first column through the eighth column contain the distributions of the target payout ratio (r), the constant (α), the speed of adjustment coefficient (γ), the coefficient of expectations (δ) and their "t" values. The last column contains the distribution of the sum of squares residual. The first row contains the means of the distributions of estimated parameters; the second row through the fourth row contain the standard error, the standard deviation, and the semi interquartile range of those distributions respectively; finally, the fifth row through the last row indicate which fractile of the distribution those rows contain.

¹Sample list of this set of firms can be found in Djarraya (1980).

From Table 1 one can see that the estimated target payout ratio is between zero and one as expected. This ratio was defined as the quotient of two unobservable variables, the desired dividend per share and the expected or permanent earnings per share. The mean of the distribution of that parameter is (.432), the median is (.380), and the dispersion as measured by the standard deviation is (.218). The distribution of the relationship between the desired dividend and the expected earnings per share varies from (.187) for the (.10) fractile to (.719) for the (.90) fractile. This relationship is strongly significant for at least 80% of the firms: the (.20) and the (.90) fractile of the "t" values of the parameter are (2.537) and (10.441) respectively. This suggests that the expected or the permanent earning per share as expressed in (5) and as a weighted average of current income and last period expectation has significant influence upon the desired dividend per share. The distribution of the constant term (α), suggested by Lintner and expected to be positive to reflect the greater reluctance to reduce than to raise dividends indicates that the positive sign is not general across all firms: the .10 fractile is -.035 and the .20 fractile is -.009. In addition, the coefficient is not significantly different than zero for at least 60% of the firms. The means and the median of the "t" values are positive but less than 1.5. This suggests that in general, the constant (α) is insignificant and could be suppressed as suggested by Fama and Babiak. Nevertheless, if the analysis is related to a particular company, this constant should be included since at least 50% of the firms have a strongly positive "t" value, the (.70) fractile is (2.738) and the (.90) fractile is (4.191).

TABLE 1

CROSS-SECTIONAL DISTRIBUTION OF REGRESSION COEFFICIENTS
 FOR THE GENERALIZED NONLINEAR MODEL
 WHEN THE DISTURBANCE TERMS ARE SERIALLY INDEPENDENT
 (ORIGINAL DATA)

	r	$t(r)$	α	$t(\alpha)$	γ	$t(\gamma)$	δ	$t(\delta)$	S.S.R
Mean	.432	5.475	.042	1.467	.612	5.317	.162	3.006	.3016
ST. error	.024	.043	.011	.229	.044	.346	.024	.316	.1652
ST. Dev.	.218	3.867	.102	2.054	.399	3.101	.221	2.827	1.477
$(Q_3 - Q_1)/2$	.142	2.663	.028	1.574	.290	1.736	.061	.923	.043
Fractiles									
.10	.187	1.306	-.035	-1.156	.153	2.155	.032	.859	.001820
.20	.253	2.537	-.009	-.410	.270	2.896	.041	1.296	.003984
.30	.306	2.948	.002	.144	.322	3.391	.050	1.872	.006717
.40	.355	3.338	.007	.807	.424	3.844	.063	2.195	.011447
.50	.380	3.823	.017	1.409	.485	4.271	.089	2.327	.023442
.60	.447	5.068	.029	1.915	.618	5.016	.121	2.677	.038061
.70	.513	7.522	.039	2.738	.696	5.874	.141	3.228	.052276
.80	.621	8.566	.073	3.238	1.017	7.714	.187	3.844	.10541
.90	.719	10.441	.156	4.191	1.173	9.290	.346	4.787	.26878

The speed of adjustment coefficient is different than one for at least 70% of the firms included in the sample. Therefore, the informational content of dividend as explained by an adaptive expectation model is rejected for at least 70% of the sample. The mean of the estimated speed of adjustment coefficient is (.612) and the median is (.485). The mean "t" value for that estimated coefficient is (5.317) and the median "t" value is (4.271). The speed of adjustment coefficient is significantly different than zero for more than 90% of the firm, the (.10) fractile and the (.90) fractile of the "t" value are (2.155) and (9.290) respectively. An important implication of this result is that when the speed of adjustment coefficient is significantly different from one, the use of the adaptive expectation model is inappropriate. In fact, the adaptive expectation model is only a particular case of the generalized model when (γ) is equal to one. Therefore, the models of those who assume that dividend payments are a function of expected earnings only without including the adjustment process specified by Lintner are misspecified and the resulting estimated coefficients are biased if the generalized model is expressed by (10) is the true model.

Similarly, the coefficient of expectation (δ) within the generalized model is far below one. The mean of the estimated parameter is (.162) and the median is (.063). The mean "t" value for that estimated parameter is (3.006) and the median "t" value is (2.327). In addition, more than 60% of the firms in the sample have a coefficient of expectation significantly different than zero. The (.40) fractile and (.90) fractile of the "t" value of the estimated coefficient of expectation are (2.195) and (4.787) respectively.

The implication of this result is that the partial adjustment model as specified by Lintner and extended by Spies (1974) and others is probably quite often a misspecification of expectations formation in the adaptive sense. In fact, the partial adjustment model is only a particular case of the generalized model as expressed by equation (10) when (δ) is equal to one. Furthermore the speculation of Fama and Babiak that the expectation coefficient (δ) is "in general close to one" is not valid at least for this sample and for the period covered by this study.

Finally, the distribution of the sum of squares residual indicates that 80% of the firms have a sum of squares residual for the generalized model of dividend behavior less than (.1). The (.80) fractile is (.10541) and the (.10) fractile is (.0018) and the semi-interquartile range is only (.043). Since the mean of the distribution of the sum of squares residual is equal to (.3016), this points out that there are some firms that have a relatively high value for the sum of squares residual. The reasons of these differences in sum of squares residual will be discussed later when seasonalities are tested and the dividend behavior of each individual firm is analyzed.

Table 2 presents the cross-sectional distributions of the estimates of the parameters of the generalized model as expressed by (10). In this second test, the data is still seasonally unadjusted but it is assumed that the disturbance terms are auto-correlated. In other words, (u_t) is assumed to be equal to $(\rho u_{t-1} + v_t)$ where (v_t) is independently, identically distributed with mean equal to zero and variance equal to $(\sigma^2 v)$. The headings of the first eight columns and the last column of Table 2 have the same meaning as the column headings in Table 1 as

TABLE 2

CROSS-SECTIONAL DISTRIBUTION OF REGRESSION COEFFICIENTS
FOR THE GENERALIZED NONLINEAR MODEL WHEN DISTURBANCE TERMS ARE AUTOCORRELATED
(ORIGINAL DATA)

	r	t(r)	α	t(α)	Y	t(Y)	δ	t(δ)	ρ	t(ρ)	S.S.R
Mean	.445	4.889	.059	.774	.491	2.692	.176	2.191	-.072	-.414	.2922
ST. error	.026	.419	.024	.141	.046	.253	.026	.151	.026	.150	.0159
ST. Dev.	.238	3.748	.221	1.266	.417	2.268	.239	1.357	.233	1.342	1.4287
$(Q_3 - Q_1)/2$	.124	2.472	.026	.819	.348	.548	.062	.757	.138	.650	.0422
Fractiles											
.10	.177	.669	-.034	-1.152	.142	1.009	.025	.522	-.338	-2.158	.001777
.20	.251	2.058	-.002	-.313	.239	1.634	.040	1.040	-.252	-1.608	.003973
.30	.320	2.548	.003	.250	.297	1.877	.054	1.418	-.174	-.909	.006166
.40	.350	3.074	.012	.404	.355	2.146	.065	1.692	-.130	-.450	.011428
.50	.390	3.448	.015	.747	.411	2.308	.094	1.956	-.102	-.256	.02256
.60	.457	4.236	.030	1.121	.559	2.589	.116	2.290	-.046	-.122	.035476
.70	.499	6.883	.039	1.607	.826	2.785	.160	2.758	.013	.044	.051428
.80	.625	7.850	.069	1.952	.985	2.853	.202	2.982	.068	.301	.1024
.90	.781	10.623	.128	2.305	1.172	3.891	.412	3.875	.182	.798	.2632

do the labels of the rows. The ninth and the tenth column contain the distributions of the auto-correlation parameter (ρ) and the "t" value of that parameter.

Again, the estimated target payout ratio is between zero and one as expected. The mean of the distribution of that parameter is (.445) and the median is (.390). The significance of the relationship between the desired dividend per share and the expected earning per share is not general across firms. The (.10) fractile of the "t" value of that parameter is (.669), but as in Table 1, more than 80% of the firms have a target payout ratio significantly different than zero. The mean "t" value for that estimated parameter is (4.889) and the median is (3.448) slightly lower than the mean and the median of the distribution of that coefficient in Table 1. Similarly, the "t" values of the distributions of the speed of adjustment coefficient and the coefficient of expectation are lower than those of Table 2. This can be explained easily by the fact that the model has now six coefficients instead of five. In addition, the number of observations is reduced by one because of the assumption that $u_t = \rho u_{t-1}$. Therefore, two degrees of freedom have been lost. Furthermore, the estimated auto-correlation coefficient might be related to the other estimated parameters, r , α , γ and δ ; increasing the standard error of the estimated parameters and hence reducing the "t" values of those parameters.

The estimated auto-correlation coefficient (ρ) is on average negative. The mean of the distribution of that estimated coefficient is (-.072) and the median is (-.102). The negative relationship is not

general across firms: the (.70) fractile is (.013) and the (.90) fractile is (.182). The results are in accordance with the Fama and Babiak (1968) finding that "when auto-correlations for firms are non zero, they will generally be negative and somewhere between zero and (-.2)". The (.80) fractile of (ρ) is only (.068) and the (.20) fractile of the same parameter is (-.252). More important, strong positive or negative serial dependence in the disturbances of the generalized dividend behavior model is not a general phenomenon. The (.20) fractile of the "t" values for the estimated coefficient is (-1.608) and the ".90" fractile is only (.789).

In summary, one can suggest that on general, neither the partial adjustment model alone the adaptive expectation model alone explains the dividend behavior of American firms. The results of Tables 1 and 2 reveal that the expectation coefficient (δ) is different than one and that the speed of adjustment coefficient is also different than one. Since both coefficients are significantly different than zero, the generalized model is the most appropriate specification of the dividend behavior of American firms. Waud (1968) has shown the extent of the bias in the estimated regression coefficients, their estimated standard errors and the estimated mean lag which results when the reduced form of either the partial adjustment model or the adaptive expectation model is assumed when in fact the generalized model is the correct specification. Finally, it is found that serial dependence in the disturbances of the specified dividend behavior model is in general negative but not significantly different than zero. Nevertheless, the investigation of the

serial dependence should be investigated when the generalized dividend behavior model is tested for a particular company. In fact, at least 10% of the firms investigated reveal that the auto-correlation coefficient is strongly negative and that the (.10) fractile of the "t" value of that coefficient is (-2.158).

However, the above results could be criticized by the fact that this study is using quarterly earnings. There may well be a seasonal effect in those earnings which might influence the results of the estimated parameters. Furthermore, Laub (1970) has shown that the percentage of dividend change is higher during the first and fourth quarter than it is during the second and third quarter of the year. Therefore, seasonalities of dividends and earnings data should be investigated and discussed.

IIIB. Investigation of seasonalities in dividends and earnings data

The empirical results obtained from the X-11 developed by Shiskin et. al. (1967) reveal that seasonality does exist in the historical data of 65 of the 80 companies for earnings per share and 37 of the 80 companies for dividend per share.

Howard Johnson Co. (retail-eating places) has the highest F ratio for the earning variable which is equal to (148.044). This ratio is equal to (145.27) for Flintkote Co. (paving and roofing materials). Similarly, the seasonality is also present and important in the drug industry as expressed by Balog and Talbot (1975)

there is a distinct seasonality to health care expenditures. The incidence of respiratory infections follows the cycle of the weather, showing valleys in the summer and peaks in the winter, as one might expect.

Also, the automotive industry which is the biggest business in the United States is a seasonal industry. The F ratio reflecting the importance of seasonalities in earnings for General Motors is equal to (72.42) and for Borg-Warner Co. is equal to (57.54). The fluctuation of earnings is one of the reasons that make the automotive industry diversify geographically and into like and unlike fields as explained by Jouppi (1975)

the cyclicity of the industry has caused managements of the auto industry itself and those industries which supply it to diversify outside the industry. Thus we find General Motors as a major developer and marketer of Frigidaire household products...and Borg Warner a major factor in air conditioning. The examples of diversification are present in almost every company commonly declared to be auto-related.

Although seasonality in earnings data is very significant for most industries, this is not the general case for all industries. Seasonality in earnings data is found to be trivial especially for the aircraft, ship-boat building and repairing, bituminous coal and lignite industries.

Regardless of the fact that dividend paid per share is considered as stable overtime, the results of the tests performed for each company reveal that seasonality in the historical data of the dividend variable does exist for more than 46% of the sample of firms in this study.

The F ratio is equal to (308.89) for Maytag Co. in household appliance industry, (119.10) for Wrigly Jr., Co. in the candy and other confectionary industry, (118.43) for Eastman Kodak Co. in photographic equipments and supply industry. This seasonality in dividend per share may be explained by the fact that some of the percentage of extra-dividend declaration and of regular dividend changes are higher during the fourth quarter than the other quarters for many companies. This

phenomena can be seen in Laub study related to the "dividend-earnings relationship."

Given these facts related to the significance of seasonalities in dividends and earnings data, the generalized model is reestimated using seasonally adjusted data. The differences between the results of the original series and the adjusted series will be compared and discussed.

IIIC. Analysis of the results when the data is seasonally adjusted

After seasonally adjusting the earning and the dividend variables using the "X-11" computer program developed by Shiskin, Musgrave and Young (1967), the parameters of the generalized model are reestimated for each of the 80 individual companies in the sample. Table 3 summarizes the cross-sectional distributions of parameters estimates obtained when Marquardt's non-linear least squares regression was used to estimate the coefficients of equation (10). The disturbance terms are assumed to be serially independent as is the case in Table 1; the only difference in this analysis is the use of seasonally adjusted data instead of the original one. The results related to the investigation of the existence of serial dependence in the disturbances of the generalized dividend behavior model of the firm is presented in Table 4.

The headings of the columns in Table 3 have the same meaning as the column headings in Table 1 as do the labels of the rows. Similarly, the headings of the columns in Table 4 have the same meaning as the column headings in Table 2 as do the labels of the rows.

Under the assumption of serial independence of the disturbance terms and with seasonally adjusted data, Table 3 reveals that the mean

TABLE 3

CROSS-SECTIONAL DISTRIBUTION OF REGRESSION COEFFICIENTS
 FOR THE GENERALIZED NONLINEAR MODEL
 WHEN THE DISTURBANCE TERMS ARE SERIALY INDEPENDENT
 (THE DATA IS SEASONALLY ADJUSTED)

	r	$t(r)$	α	$t(\alpha)$	γ	$t(\gamma)$	δ	$t(\delta)$	S.S.R
Mean	.435	5.923	.036	1.510	.478	4.411	.232	2.718	.1165
ST. error	.030	.516	.010	.216	.039	.291	.031	.235	.0596
ST. Dev.	.270	4.616	.091	1.940	.353	2.605	.281	2.110	.533
$(Q_3 - Q_1)/2$	.124	2.862	.019	1.288	.288	1.521	.102	.887	.021
Fractiles									
.10	.170	.854	-.019	-.873	.113	1.848	.032	.979	.001305
.20	.233	2.449	-.003	-.272	.186	2.566	.044	1.397	.00245
.30	.292	3.014	.003	.491	.253	2.813	.060	1.629	.005706
.40	.338	3.681	.007	.871	.305	3.363	.080	2.050	.008570
.50	.370	4.034	.014	1.338	.375	3.962	.116	2.340	.017993
.60	.450	4.983	.020	1.915	.456	4.261	.160	2.903	.024701
.70	.485	7.772	.033	2.607	.558	4.754	.218	3.095	.038114
.80	.570	8.996	.052	3.044	.739	6.360	.347	3.373	.072181
.90	.677	11.966	.143	3.803	.992	7.261	.678	4.013	.21592

TABLE 4

CROSS-SECTIONAL DISTRIBUTION OF REGRESSION COEFFICIENTS
FOR THE GENERALIZED NONLINEAR MODEL WHEN DISTURBANCE TERMS ARE AUTOCORRELATED
(SEASONALLY ADJUSTED DATA)

	r	$t(r)$	α	$t(\alpha)$	γ	$t(\gamma)$	δ	$t(\delta)$	ρ	$t(\rho)$	S.S.R
Mean	.435	5.538	.030	.979	.441	2.548	.275	2.427	-.104	-.607	.1080
ST. error	.025	.506	.008	.146	.039	.146	.040	.204	.029	.196	.052
ST. Dev.	.228	4.530	.007	1.306	.356	1.314	.364	1.829	.263	1.756	.473
$(Q_3 - Q_1)/2$	.121	2.761	.018	.957	.250	.413	.132	.799	.172	.922	.021
Fractiles											
.10	.201	.786	-.016	-.743	.105	1.438	.031	.786	-.398	-2.358	.00118
.20	.246	2.376	-.001	-.252	.133	1.742	.049	1.290	-.330	-1.886	.00237
.30	.310	2.860	.001	.244	.202	1.995	.069	1.474	-.267	-1.420	.00541
.40	.336	3.329	.004	.628	.249	2.132	.084	1.811	-.197	-1.119	.00817
.50	.400	3.766	.011	.867	.314	2.263	.106	2.026	-.149	-.713	.01514
.60	.445	4.685	.018	1.472	.397	2.521	.181	2.466	-.096	-.427	.02365
.70	.492	6.046	.026	1.776	.573	2.608	.213	2.734	-.021	-.076	.03706
.80	.570	8.803	.044	2.101	.696	2.846	.413	3.135	.093	.357	.07090
.90	.721	12.552	.115	2.467	1.078	3.695	.815	3.658	.227	.792	.21232

of the distribution of the target payout ratio and the median of that distribution are almost unchanged. The mean of the distribution of the target payout ratio is equal to .435 when the data is seasonally adjusted versus .432 when the data is seasonally unadjusted. This can be explained by the fact that dividend decision makers look to the long run expected earnings estimate when deciding for the desired dividend payments. Furthermore, among the factors considered by management while taking dividend decision are the fluctuations and seasonalities in earnings. The stability of the target payout ratio whether the data is seasonally adjusted or unadjusted can explain the awareness of management of the relationship between expected earnings (E_t^*) and the desired dividend (D_t^*). In addition, this stability can also be considered as a general phenomenon across firms. A comparison of Table 1 and Table 3 shows that the different fractiles of the distribution of the target payout ratio for seasonally adjusted and unadjusted data are slightly different. Similarly, as the case in Table 1, the relationship between the desired dividend per share and the expected earnings per share is very strong for more than 80% of the firms in the sample. The (.20) fractile of "t" values for the estimated target payout ratios is (2.449) and the (.90) fractile is equal to (11.966). The distribution of the "t" values of the estimated target payout has a mean of (5.923) and a median of (4.634). Therefore, expected earnings is a very important factor in explaining the desired amount of dividends to be paid to stockholders and should be included instead of current earnings.

The constant term reflecting the greater reluctance on the part of management to reduce dividends than to raise them is an average non -

significantly different from zero. The mean of the distribution is (.036) and the median (.014). The constant term is not always positive as stipulated by Lintner and as expected since the (.20) fractile is equal to (-.003). Nevertheless, more than 70% of the firms have a positive constant term and at least 30% of the firms have a significantly positive constant term. Therefore, the results related to the constant term and to the target payout ratio are not very different than those in Table 1 where the data is unadjusted.

As can be seen in comparing Table 1 and 3, the mean of the distribution of the estimated speed of adjustment coefficient has decreased from (.6212) to (.4785) and the estimated coefficient of expectations increased from (.162) to (.232) when the seasonal fluctuations are smoothed out. Therefore, the higher are the seasonal fluctuations and the stronger are the cyclical components of earnings and dividends, the faster is the adjustment process and the lower is the profit expectation coefficient.

This kind of pattern is in accordance with the finding of Spies while studying the influence of the nature of the demand for the products of a corporation on its adjustment process:

It is interesting to note that the two industries exhibiting the most rapid adjustment are the electrical and other machinery industries. The products of both of these industries are sold mainly to other firms rather than to consumers. As a result the demand for their products is highly cyclical. On the other hand, the industries exhibiting the slowest adjustment, paper and food, face demands that have very small cyclical components. The rest of the industries generally follow the same pattern: the more cyclical the demand the faster the adjustment. It is apparent that corporations which normally experience a cyclical variation in demand become accustomed to it and adapt their decision-making process accordingly. The industries with smaller cyclical

components, on the other hand, tend to be more cautious about deviating from the prevailing trend and are much more apt to take a wait-and-see approach ...

The increase of the coefficient of expectation when the data is seasonally adjusted can also be explained easily. In fact, if it is assumed that earnings are constant and without any seasonal fluctuations; the expected earnings will be equal to current earnings as expressed in equation (2) and the coefficient of (δ) will be equal to one. On the other hand, if earnings are random and that current earnings does not have any effect in predicting expected earnings the coefficient of (δ) as expressed in equation (2) will be equal to zero. Therefore, the estimated coefficient of expectations (δ) can be considered as tool to measure the degree of fluctuations in earnings.

The lower are the seasonal fluctuations, the higher is the coefficient of expectations; and conversely, the higher the seasonal fluctuations, the lower is the coefficient of expectations.

The distribution of the estimated speed of adjustment coefficient indicates that most firms have a coefficient between zero and one as expected. The (.10) fractile is (.113) and the (.90) fractile is (.99). Furthermore, this coefficient is significantly different than zero for more than 80% of the firms in the sample. The (.20) fractile is (2.566) and the (.90) fractile is (7.261).

Similarly, the distribution of the estimated coefficient of expectations shows that the estimated coefficients are within the expected interval and with the expected sign. Nevertheless, at least 30% of the firms have a (δ) value not significantly different than zero. The (.30) fractile of the "t" value is (1.629) and the (.40) fractile is (2.050).

As indicated earlier, this lack of significance of the value (δ) for a certain number of firms can be explained by the fact that earnings are fluctuating randomly from one quarter to another.

Finally, the distribution of the sum of squares residuals indicates that the means has decreased from (.3016) in Table 1 to (.11658) in Table 3. Similarly, the value of each fractile of the distribution of sum of squares residuals in Table 4 is lower than the value of the component fractile in Table 1. This is mainly because the seasonal fluctuations have been smoothed out.

Finally, Table 4 shows the cross-sectional distribution of the estimated parameters of the generalized non linear model when serial dependence in the disturbance terms is assumed and when the data is seasonally adjusted.

As in Table 2, the distribution of the estimated auto-correlation coefficient shows that this coefficient is generally negative. The (.10) fractile is (-.398) and the (.80) fractile is (-.021). Nevertheless, this negative relationship is not very strong. The mean of the "t" value of the estimated auto correlation coefficient is only (-.607) and the (.20) fractile is (-1.886). Therefore, less than 20% of the firms have an auto-correlation coefficient significantly different than zero.

The mean of the estimated target payout ratio is around (.43) as in the case when the data is seasonally unadjusted and it is significantly different than zero. The mean "t" value for that estimated ratio is (5.53). The intercept (α) is still significantly different than zero but has the positive sign for more than 70% of the firms.

Again, the mean of the distribution of the speed of adjustment coefficient is lower when the data is seasonally adjusted than in Table 3. The mean of the distribution of the coefficient of expectations is higher in Table 4 than in Table 3 when the data is seasonally unadjusted. The reasons behind this change are discussed earlier in this section.

In summary, all the results indicate whether the data is seasonally adjusted or unadjusted and whether the disturbance terms are assumed to be serially dependent or independent that in general, neither the partial adjustment model nor the adaptive expectation model is the correct specification of the dividend behavioral model of American firms. Furthermore, the results discussed indicate that the constant term proposed by Lintner is on average not significantly different than zero. Finally, the auto-correlation coefficients are generally negative, but strong negative or positive serial dependence is not a general phenomenon.

IV. Summary

Based upon the practical decision process of managers, finance theory and modern econometric methods, a generalized dividend payments behavior is derived and analyzed. It is analytically shown that the residual theory of dividends, a partial adjustment model and information content model are all special cases of the generalized model derived in this paper. In terms of eighty industrial firms' quarterly earnings and dividends data, Marquardt's non-linear regression method is used to estimate the parameters of the generalized model. It is shown that the generalized dividends behavior model can effectively identify individual firm's dividend decision behavior. It is not unreasonable to conclude

that this study has successfully developed a new dividend decision model for theoretical and theoretical dividend decision in the financial management.

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