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THE DIVIDEND EFFECT OF THE ELECTRIC UTILITY INDUSTRY*

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I. Introduction

Many cross-sectional studies, including Gordon (1959), Durand (1959), and others have employed either the linear or the logarithmic linear relationship between prices and both dividends and retained earnings to explain price variations in samples of companies drawn from a particular industry. They have concluded that the dividend multiplier in general is several times the retained earning multiplier. Using a specification analysis technique, Friend and Puckett (1964) examined the existence of possible specification biases of previous studies in comparing the importance of the dividend effect relative to the retained earning effect. In the univariate regression model, it is generally found that dividend payments and share values in the electric utility industry are positively and significantly correlated.

Miller and Modigliani [1961, 1966] and Higgins [1974] have used a finite-growth valuation model to show the independence of share values and dividend policy. Estimated earnings instead of actual earnings are employed in the finite growth model to test the dividend effect in the electric utility industry. The main justification of using estimated earnings is to reduce the measurement error associated with observed earnings. In other words, the permanent component of earnings is used to explain the variation of share values.

The main purposes of this paper are to investigate the weaknesses in previous models used to test the dividend effect in the electric utility industry and to propose an alternative multivariate regression model i.e., seemingly unrelated

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regression (SUR) model to re-examine the dividend effect in the electric utility industry. Zellner's (1962) SUR model employs the generalized least squares (GLS) method to handle the strong interrelationship among the residuals of a set of cross-sectional regressions.[1)] He shows that this method of dealing with the so-called "firm effects" is more meaningful than those used by Bower and Bower (1969) and Chung (1974).

In the second section the traditional methods of testing the dividend effect are reviewed and re-examined. In the third section a multivariate regression model is derived to integrate the traditional methods used in testing the relative importance of the dividend effect. In the fourth section the implications of this multivariate type model are discussed. It is further shown that the firm effect approach used by Bower and Bower (1969) and Chung (1974) is a special case of this model. Data from 116 electricity firms are used to test the validity of the new model relative to that of the standard model. The empirical results are also used to demonstrate Granger's (1975) conclusions that the standard cross-sectional model of testing the dividend effect do not always hold. Finally, the results of this study are summarized.

II. Review and Critique of Existing Methods for Testing the Dividend Effect

Both time-series and cross-section methods have been used to study the variation of stock price. However, the cross-section method is generally employed to test the relative importance of dividend policy. Following Gordon (1959), Durand (1959) and Friend and Puckett (1964), the deterministic cross-section relationship between stock prices, dividends, and retained earnings is defined as

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[1)] Further discussion on the property of SUR can be found in Kamenta and Gilbert (1968) and Telser (1964).

$$P_{ti} = a + bD_{ti} + CR_{ti} \qquad \begin{matrix} (i = 1, 2, \ldots, N) \\ (t = 1, 2, \ldots, T) \end{matrix} \qquad (1)$$

where P_{ti}, D_{ti}, and R_{ti} represent per share price, dividend, and retained earnings respectively. The subscript i denotes the i^{th} company in a sample of n companies selected from a particular industry and all variables are measured in the t^{th} time period.

To explore the impact of omitted variables on testing the dividend effect, Friend and Puckett (1964) [FP] stated that omitted variables may include subjective risk evaluation, profitability of investment opportunities, and sources of expected future financing and accounting differences. Furthermore, they pointed out that it is possible to take an indirect approach instead of the direct approach to account for the effect of omitted variables. They argued that the effects associated with all omitted variables can be aggregated and treated as a composite (firm) effect. Theoretically, they showed that a continuous regression approach should be used to improve the regression relationship. But they were unable to find an acceptable continuous regression method for this purpose and therefore, introduce some proxy explanatory variables in equation (1). Bower and Bower (1969) [BB] proposed the use of weighted residuals from previous cross-sectional regressions as a proxy for the firm effect for the current cross-sectional regression. The additional explanatory variables proposed by FP and BB include only the historical firm effect information and a subjective judgment which should be used to choose either the new explanatory variable or weights for constructing the new explanatory variable. Hence, both the FP and BB methods are not robust enough to handle the firm effect problem. A generalization of BB's residual proxy method will be derived in the following section to simultaneously take care of both lag and lead effects associated with stock price variations.

To criticize model (1) in testing the relative importance of the dividend effect, Miller and Modigliani (1961, 1966) [M & M] argued that expected instead of current earning should be used to evaluate the importance of the dividend effect in the electric utility industry. They used the two-stage least squares (2SLS) method to remove the measurement error associated with current earnings and concluded that dividend policy was not important to stock values of the electricity industry. M & M's results caused some comments by Gordon (1967) and others. Based upon the content of the finite growth model which is similar to M & M's specification, Higgins (1974) claimed that he has demonstrated the irrelevance of dividend policy for the electric utility industry without resorting to M & M's complicated and controversial estimating techniques.

Both M & M and Higgin's results need to be re-examined. For estimating the cost of capital to the electric utility industry, M & M applied the 2SLS to estimate relevant parameters. After testing the relevance of dividend policy, M & M regarded their results of 2SLS as striking. Now, it will be shown that the M & M results face the multicollinearity problem associated with 2SLS. The two-equation model employed by M & M to test the relevance of dividend policy can be defined as:[2)]

$$X_{tj} = a_1 Y_{tj} + a_2 Z_{1tj} + a_3 Z_{2tj} + a_4 (Z_{5tj} - \lambda Y_{tj}) + U_{tj} \qquad (2A)$$

$$Y_{tj} = b_0 + b_1 Z_{1tj} + b_2 Z_{2tj} + b_3 Z_{3tj} + b_4 Z_{4tj} + b_t Z_{5tj} + W_{tj} \qquad (2B)$$

Where at time t for the j^{th} firm,

X_{tj} denotes the value of a firm, Y_{tj} refers to earnings, Z_{1tj}, Z_{2tj}, Z_{3tj}, Z_{4tj}, and Z_{5tj} represent size, growth, debt, preferred stock, and dividends for a firm respectively, and λ is the sample average of pay-out ratio, and

2) The justification of this model can be found in Miller and Modigliani [1966, pp. 351-356].

both U_{tj} and W_{tj} are error terms with classical assumptions. Two alternative estimation methods were employed by M & M to test the relevance of dividend policy. When the direct OLS was used to estimate equation (2A), they found that the dividend coefficients were positive and relatively significant for all three years. However, they obtained negative and non-significant dividend coefficients for all three years when 2SLS was applied to equation (2A). They regarded their 2SLS results as striking. Since M & M's first-stage empirical results [See M & M, p. 361] show that the explanatory power of equation (2B) is essentially due to the dividend variable, the correlation coefficient between the estimated earnings $(\hat{Y})$ and dividends (Z_5) is approximately equal to unity. When estimated earnings instead of actual earnings is used in equation (2A), the dividend coefficients are subject to the strong multicollinearity problem associated with 2SLS.[3)] The impact of this kind of multicollinearity associated with 2SLS has been investigated in detail by Klein and Nakamura (1962) and Fox (1968). Moreover, the $\bar{R}^2$ of M & M's first stage regressions are only .50, .49, and .40 for 1957, 1956 and 1954 respectively. Hence, M & M's 2SLS estimators also are inefficient.

Now, we will examine Higgins' (1974) empirical results of testing the dividend effect in the electric utility industry. By comparing his Tables 2 and 3, it can be concluded that D/A $\left[\frac{\text{total dividend payment}}{\text{book value of total asset}} \right]$ is highly correlated with 1/A $\left[\frac{1}{\text{book value of total asset}} \right]$. In other words, the regression coefficient associated with D/A may be strongly affected by

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[3)]From the appendix B of M & M's paper, it is found that the correlation coefficients between actual earning and dividends are .66, .63 and .55 for 1957, 1956 and 1954 respectively. This implies that M & M's OLS results are subject to relatively less important multicollinearity problems.

multicollinearity[4)] In the following section, a new model of testing the dividend effect is derived.

III. A Multivariate Regression Model for Testing the Dividend Effect

Equation (1) can be used to delineate alternative specifications of the relationship between stock price, dividends, and retained earnings. For a particular firm, equation (1) can be used to describe the time-series relationship; at a particular time period, equation (1) can also be used to investigate the cross-sectional relationship within an industry. These two alternative approaches are generally used to test the importance of the dividend effect relative to the retained earnings effect. Theoretically, factors affecting the variation of stock price, dividends, and earnings can be either the components associated with the time period or the components associated with the individual firm. The components associated with a particular time period change over time and the components associated with the individual firm hold constant over time. Since the standard cross-sectional regression can only take the factors associated with particular time period into account, there exists some information left in the cross-sectional regression residual term. Telser (1964) has regarded this type of regression as a successive cross-section. It is often observed that corresponding residuals of successive cross-sections are correlated. If the residuals of successive cross-sections are correlated, then the traditional single equation methods [time-series and cross-sectional violate an implicit assumption, namely, that there exist no other regression models with a

[4)]This conclusion is based upon the facts: (i) the regression estimates of Table 2 are almost identical to those of Table 3 except the regression coefficient associated with 1/A, and (ii) the summation of the regression coefficient associated with 1/A and the regression coefficient associated with D/A (from Table 3) is approximately equal to the regression coefficient associated with 1/A (from Table 2).

disturbance term that would be correlated with the residual of the particular regression of interest.[5] If this implicit assumption is violated, then the estimates of the regression equation are not efficient. One method used to deal with this problem is to introduce dummy variables into the regression equations in an attempt to remove the common influences that might be the sources of the correlation among the residuals. Alternatively, Telser (1964) has derived an iterative method to exploit these correlations directly by introducing residuals from other cross-sectional regressions into the given regression equation. Following Telser (1964), the iterative estimation method for the linear equation system of (1) can be briefly described as following.

In terms of matrix notation, a stochastic specification of equation (1) can be rewritten as

$$P_t = Z_t b_t + u_t \qquad (t = 1, 2, \ldots, T) \tag{3}$$

where

P_t = N x 1 column vector of the "dependent" or endogenous variables

Z_t = N x 3 matrix of "explanatory" exogenous variables

u_t = N x 1 column vector of a random disturbance

b_t = 3 x 1 column vector of the unknown parameters to be estimated

To take care of the correlation among the disturbance terms, Telser respecified equation (3) as

$$P_t = Z_t b_t + U_t a_t + V_t \qquad (t = 1, 2, \ldots, T) \tag{4}$$

where $U = [U_1, U_2, \ldots, U_T]$ is an N x T matrix whose elements are the OLS residuals, U_t = Matrix U excluding the t^{th} column, and V_t is the disturbance term of equation (4).

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[5] See Kmenta (1971, p. 202).

Equation (4) contains two kinds of variables, the non-stochastic Z's and the random variables U_t's that are uncorrelated with the V's. Although we can not observe the U_t's, we do have consistent estimates of them provided by the simple OLS estimates of the b's. An equation used to describe the iterative estimation of equation (4) can be defined as:

$$Y_t = Z_t\, b_t\,(i) + [u_1\,(i)\ \ldots\ u_{t-1}\,(i)\ u_{t+1}\,(i-1)$$

$$u_T\,(i-1)]\ a_t\,(i) + V_t\,(i) \quad (5)$$

where u_t (i) represents the disturbance term of the i^{th} round estimation in the t^{th} period. The equation for calculating u_t (i) is defined as:

$$u_t\,(i) = Y_t - Z_t\, b_t\,(i) \quad (6)$$

Telser (1964) also has shown that the iterative estimate of b_t (i) converges to the GLS estimate of Aitken and Zellner. This process implies that Zellner's SUR method can be used to replace the Telser's iteration estimates of b_t. However, Telser's iteration estimation method shows us a detailed picture of the SUR method. In addition, Zellner (1971) has demonstrated that the SUR method is one type of multivariate regression.

IV. Firm Effect and the Multivariate Regression Model in Testing the Dividend Effect

In discussing the relationship between the time-series and cross-sectional data, Kuh (1959) has pointed out the possible existence of the "firm effect" in the microeconomic relationship. The possible impact of the "firm effect" on testing dividend effect was first discussed by Friend and Puckett (1964). However, they failed to find a robust method to handle this kind of effect. BB have shown that the weighted - residual method can be treated as an

additional explanatory variable in investigating the relationship between risk and value of common stock. By integrating BB's weighted residual technique into FP's firm effect concept, equation (1) can be extended as:

$$P_t = Z_t b_t' + W_t a_t + \tau_t \qquad (t = 1, 2, \ldots, T) \tag{7}$$

where W_t = N x 1 column vector. The element of W_t is a weighted average of OLS residuals obtained from previous cross-sectional regressions. This method implicitly assumes that the firm effect is due only to the lag effect. The weight used to create the firm effect variable is relatively subjective. Furthermore, the statistical properties of b_t' indicated in (7) are unknown. From a comparison of equations (4) and (7), it is not unreasonable to assume that equation (7) is a special case of equation (4). Equation (4) indicates that a model can be used to take care of the firm effect associated with either the lag or the lead effect of stock price variation. No arbitrary weights are needed in applying the model of equation (4). In addition, the statistical properties of estimates associated with equation (4) are known. Finally, the results from equation (4) describe the multivariate relationship of stock prices over time as finance theory has expected.

To test the usefulness of the multivariate regression model of equation (4) for investigating the dividend effect, data from 116 electric utility firms are used to estimate the relationship among stock price, dividend and retained earnings per share. The sample period is from 1961 ~ 1970. First, OLS is used to estimate the time series relationship of equation (1). Then the correlation coefficient matrix of the OLS residual is calculated to test the necessity of using the SUR method to improve the efficiency of the regression estimates. From the correlation coefficient matrix shown in Table I, it is found that the independence assumption among the residuals of equation (1) does not hold.

Note that the degree of relationship among the residuals is not necessarily decreased over time. This implies that the weighted residual method used by Bower and Bower (1969) and Chung (1975) are not applicable in this case.

To improve the efficiency of the cross-sectional regression estimates employed to test the dividend effect of electricity industry, the SUR method is used to estimate 10 cross-sectional equations simultaneously. The results of both OLS and SUR for these cross-sectional relationships are listed in Table II. It is found that the efficiency of SUR estimates is much higher than those of OLS. The relative magnitude between the regression coefficient associated with dividends and that associated with retained earnings is used to test the relative importance of dividend policy. OLS regression coefficients associated with retained earning are larger than those associated with dividends.[6)] Hence, we would conclude that the dividend effect is less important than the retained earning effect. However, the SUR regression coefficient estimate associated with the dividend variable are either larger or equal to those associated with retained earnings. The cross-sectional regressions with equal regression coefficients (b_t' and C_t) are 1961, 1962, 1965, 1966 and 1967. The SUR results tell us that the dividend effect may either be more important than the retained earnings effect or indifferent to the retained earning effect. The conclusion seems to imply that the relative importance of the dividend effect in the electric utility industry depends upon the economic environment faced by both the firm and the investors.

Using the optimal forecasting assumption, Granger (1975) has shown that the model specified in equation (1) generally implies the estimated "b" should be

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[6)] This finding is consistent with what FP have found.

larger than the estimated "c." The OLS results indicated in Table II do not support his conclusion. However, the SUR results are consistent with Granger's argument. Since Granger regards the disturbance structure of his model as restrictive, his model should be reconsidered in accordance with the SUR framework.

Finally, Telser (1964, p. 860) points out that the individual regression results associated with the SUR estimation method have implicitly included all of the explanatory variables in the whole equation set. This implies that estimated regression coefficients for retained earnings from the SUR method contains information from several periods. Therefore, the expected earnings concept used by both M & M and Higgins has been implicitly accounted for by the multivariate regression model derived in this paper.

V. Summary

In this paper, the methods used to test the importance of the dividend effect relative to the retained earning effect are reviewed and criticized. It is shown that the single equation cross-sectional regression method does not take the "firm effect" into account and that the methods used by M & M and Higgins are subject to a strong multicollinearity effect.

Following Telser's iterative estimation of a set of linear regression equations, a multivariate regression model for testing the dividend effect is derived. It is demonstrated that the new model has allowed the firm effect concept to be implicitly included in the empirical study of testing the relative importance of the dividend effect. It is shown that Bower and Bower's weighted residual approach of handling the firm effect is a special case of the multivariate regression model.

To test the validity of this new model, data from 116 electric utility firms are used to do empirical study. It is found that 50 percent of the cross-sectional regression results indicate an indifference between the dividend effect and the retained earning effect. It also demonstrates that Granger's (1975) interesting conclusions on the standard cross-sectional model of testing the dividend effect do not always hold.

TABLE I

Residual Correlation Matrix

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
1961	1.00	.75	.70	.67	.31	.27	.13	.55	.55	.51
1962		1.00	.82	.72	.32	.28	.13	.71	.71	.60
1963			1.00	.93	.80	-.04	-.20	.69	.62	.51
1964				1.00	.78	-.06	-.25	.61	.55	.45
1965					1.00	.78	.70	.26	.34	.31
1966						1.00	.84	.25	.29	.30
1967							1.00	.15	.21	.22
1968								1.00	.88	.74
1969									1.00	.81
1970										1.00

TABLE II

OLS and SUR - Electric Utility Industry*

(t-values appear in parentheses beneath coefficient)

		a	b	c	$\bar{R}^2$
1961	OLS	6.36	14.41	26.73	.7538
		(2.75)	(6.96)	(8.77)	
	SUR	3.86	19.35	20.52	
		(2.42)	(14.06)	(10.43)	
1962	OLS	5.55	12.52	23.95	.7535
		(2.95)	(7.35)	(8.79)	
	SUR	2.43	18.59	17.06	
		(2.20)	(19.78)	(12.19)	
1963	OLS	5.77	15.23	14.38	.6364
		(2.67)	(7.76)	(4.55)	
	SUR	1.47	20.19	11.48	
		(1.27)	(21.69)	(8.60)	
1964	OLS	7.09	15.90	9.80	.4642
		(2.49)	(6.90)	(2.66)	
	SUR	-.06	20.79	11.26	
		(-.04)	(17.52)	(6.56)	
1965	OLS	-2.57	18.34	28.51	.6903
		(-.89)	(8.62)	(8.51)	
	SUR	-4.54	22.12	24.06	
		(-2.23)	(15.29)	(10.84)	
1966	OLS	.07	13.[illegible]3	25.37	.6871
		(.03)	(6.23)	(9.34)	
	SUR	-4.31	19.35	20.81	
		(-2.79)	(14.68)	(13.15)	
1967	OLS	3.77	12.22	19.68	.5407
		(1.42)	(5.33)	(5.85)	
	SUR	-3.49	18.42	18.88	
		(-2.08)	(12.95)	(9.47)	
1968	OLS	5.22	13.75	9.88	.6623
		(2.89)	(9.54)	(5.98)	
	SUR	1.88	16.95	8.45	
		(1.49)	(18.47)	(9.06)	
1969	OLS	3.06	8.47	13.92	.6414
		(1.72)	(6.01)	(8.27)	
	SUR	.55	12.45	9.68	
		(.44)	(13.66)	(10.29)	
1970	OLS	5.81	8.66	11.53	.6351
		(2.36)	(4.99)	(6.60)	
	SUR	4.11	11.99	7.03	
		(2.11)	(9.14)	(5.93)	

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