RATIONAL EXPECTATIONS AND THE FIRM'S DIVIDEND BEHAVIOR

Alice Nakamura and Masao Nakamura*

Abstract—In Lintner's model of the dividend behavior of firms the change in dividends is a function of current earnings and the lagged dividends. We show that under a rational expectations hypothesis of management behavior the change-in-dividends equation should include lagged earnings as an additional explanatory variable, and that the expected sign of the coefficient of the lagged earnings variable is positive. Fama and Babiak predicted the opposite sign for a lagged earnings variable in such an equation. Estimation and simulation results based on panel data for U.S. and Japanese firms provide modest econometric support for our Rational model.

A good descriptive model of firms' dividend policies is useful, for example, for portfolio managers and for studying aspects of firm behavior such as interactions between investment and financing decisions and the management's transmissions of signals concerning changes in expected future earnings.[1] The econometric specifications of dividend behavior favored in the literature are the Lintner model (Lintner (1956)) and its Fama-Babiak (FB) variant (Fama and Babiak (1968)). In the Lintner model the change in dividends is regressed on the current earnings and the lagged dividends. Fama and Babiak (1968) note that the forecasting ability of Lintner's model is increased by adding the lagged earnings as a regressor. We show that under a rational expectations hypothesis the dividend behavior of firms may be described by an extension of Lintner's model, that we call the Rational model, that includes the lagged earnings as an additional explanatory variable. An important empirical difference between our Rational model and the FB model is that the expected sign of the coefficient of the lagged earnings variable is negative in the Rational model while in the FB model it is implied to be positive (see Fama and Babiak (1968, equation 10)). Our results based on panel data for U.S. and Japanese firms provide modest support for the Rational model.[2]

I. The Rational Model of Dividend Behavior

Our point of departure is the partial adjustment model of the dividend behavior of a firm (Lintner (1956)) given by

$$\Delta D_t = a_0 + c(D_t^* - D_{t-1}) + u_t; \qquad t = 1,2,\ldots,T \quad (1)$$

where $\Delta D_t = D_t - D_{t-1}$ denotes the change in dividends, D_t is the dividends paid out in time period (year) t, D_t^* is the unobserved target dividend payout, c is the speed of adjustment to the difference between the target dividend payout and last year's payout, a_0 is a constant and u_t is an error term often assumed to be independently and normally distributed with zero mean over time periods. In the Lintner model the target dividend payout is replaced by $D_t^* = ry_t$ which means that the desired dividend payout is a fraction r of the current earnings (y_t). Thus Lintner's model is

$$\Delta D_t = a_0 + cry_t - cD_{t-1} + u_t. \quad (2)$$

This model fits U.S. data (at both aggregate and disaggregate levels) quite well.

Suppose instead that management determines the target dividend payout by

$$D_t^* = ry_p^t \quad (3)$$

where y_p^t, the permanent earnings of the firm as perceived by management, is given by

$$y_p^t = \alpha\left\{\sum_{j=0}^{\infty} b^j E_t y_{t+j}\right\}, \quad (4)$$

Received for publication May 1, 1984. Revision accepted for publication February 13, 1985.

*University of Alberta.

This research was supported in part by a McCalla Research Professorship awarded to the authors and by a grant from the D. Muir Fund of the University of Alberta. The authors wish to thank two anonymous referees for helpful comments on earlier versions of the paper.

---

[1] See, for instance, Mayer, Duesenberry and Aliber (1984, pp. 21–22 and p. 110), Fama (1974), Duesenberry (1958, p. 101) and Watts (1973) for these applications.

[2] We treat the change-in-dividends equation in isolation in this study. A multiple equations framework might seem more appropriate on theoretical grounds, but such models have not been found to provide good descriptions of dividend behavior in empirical studies. For instance, in commenting on their own multiple equations models, Jalilvand and Harris (1984, p. 142) note: "One shortcoming of this work is its inability to obtain a detailed explanation of firms' dividend adjustments."

and where[3] b is the management's discount rate ($0 < b < 1$), α is the rate of return on the market value of the firm and E_t is the conditional expectations operator given the information set $I(t)$ available to the management in period t; i.e., $E_t y_t = E(y_t | I(t)) = y_t$ and $E_t y_{t+j} = E(y_{t+j} | I(t))$ for $j = 1, 2, \ldots$. It is assumed, as in the literature, that $I(t)$ includes y_t, the current earnings, and hence the dividend decision is assumed to be made after the current earnings have become known to the management. In (4), $\sum_{j=0}^{\infty} b^j E_t y_{t+j}$ represents the present value of all future discounted earnings expected by the management, and is the market value of the firm expected by the management in year t. Then (4) states that the firm's permanent earnings, as perceived by the management in t, are the return on the expected market value of the firm in t.

If the stochastic process for earnings is a random walk with drift given by

$$y_{t+1} = y_t + \delta + v_{t+1}, \qquad t = 0, 1, 2, \ldots, \tag{5}$$

where[4] δ is a drift term (known to the management) representing the firm's expected growth and v is a random term which is independently and normally distributed with zero mean over time, then the permanent earnings of the firm as defined by (4) satisfy the following rational expectations restriction:

$$E_t y_p^{t+1} = y_p^t + \alpha(\delta/(1-b)) \tag{6}$$

where

$$y_p^{t+1} = \alpha \sum_{j=0}^{\infty} b^j (E_{t+1} y_{t+1+j}). \tag{7}$$

Equation (6) states that the management's expected permanent income in $t+1$ given its information set in t must equal the sum of the permanent income in t and the return (in all future periods) from the growth in the firm's earnings over $t+1$. The second term on the right-hand side of (6) represents the return (at the rate α) from the present market value of new growth which results in additional earnings in all future periods; i.e., $\delta + b\delta + b^2\delta + \cdots = \delta/(1-b)$. Since δ is assumed to be known to the firm's management, δ is in the information set $I(t)$ for any t. If there is no drift, δ is set equal to zero in (5) and (6). To show (6), we rewrite (7) as

$$y_p^{t+1} = \alpha y_{t+1} + \alpha \sum_{j=1}^{\infty} b^j E_{t+1} y_{t+1+j}$$

and apply E_t as follows:[5]

$$\begin{aligned} E_t y_p^{t+1} &= \alpha E_t y_{t+1} + \alpha \sum_{j=1}^{\infty} b^j E_t \{ E_{t+1} y_{t+1+j} \} \\ &= \alpha E_t y_{t+1} + \alpha \sum_{j=1}^{\infty} b^j \\ &\qquad \times E\left[E\{ y_{t+1+j} | I(t+1) \} | I(t) \right] \\ &= \alpha E_t y_{t+1} + \alpha \sum_{j=1}^{\infty} b^j E_t (y_{t+1+j}). \end{aligned} \tag{8}$$

Then, using (4) and (5) we get

$$\begin{aligned} E_t y_p^{t+1} &- y_p^t \\ &= \alpha E_t y_{t+1} + \alpha \sum_{j=1}^{\infty} b^j E_t (y_{t+1+j}) \\ &\quad - \alpha E_t y_t - \alpha \sum_{j=1}^{\infty} b^j E_t (y_{t+j}) \\ &= \alpha E_t (y_{t+1} - y_t) \\ &\quad + \alpha \sum_{j=1}^{\infty} b^j E_t (y_{t+1+j} - y_{t+j}), \end{aligned}$$

$$y_{t+j} = y_t + j\delta + \sum_{s=1}^{J} v_{t+s}, \qquad j = 1, 2, \ldots \tag{9}$$

and

$$E_t y_{t+j} = y_t + j\delta. \tag{10}$$

Substituting (10) into (9), we get

$$E_t y_p^{t+1} - y_p^t = \alpha\delta(1 + b + b^2 + \ldots). \tag{11}$$

This proves (6). Thus under our hypothesis concerning the management's rational expectations, the Rational model of dividend behavior is given by (1), (3) and (4).

---

[3] Definitions of the permanent component of earnings using an expression like (4) are found, for example, in studies testing the permanent income hypothesis using rational expectations. (See, for instance, Flavin (1981).)

[4] Empirical evidence is found in Ball and Watts (1972), Gonedes (1973) and Watts and Leftwich (1977) to support the hypothesis that firms' earnings follow the process given by (5). Note that (5) includes the standard random walk process for which $\delta = 0$.

[5] The last line of (8) follows from the previous line since $I(t)$ is a subset of $I(t+1)$. See, for example, Cinlar (1975, p. 37) for a formal proof.

II. Empirical Implementation of the Rational Model

To implement the Rational model, we rewrite the permanent earnings y_p^t in (4) using (10) as follows:

$$\begin{aligned} y_p^t &= \alpha y_t + \alpha \sum_{j=1}^{\infty} b^j E_t y_{t+j} \\ &= \alpha y_t + \alpha \sum_{j=1}^{\infty} b^j (y_t + j\delta) \\ &= \alpha y_t + \alpha \left(\sum_{j=1}^{\infty} b^j \right) y_t + \alpha \left(\sum_{j=1}^{\infty} j b^j \right) \delta \\ &= \alpha y_t + \alpha B_1 y_t + \alpha B_2 \delta \qquad (12) \end{aligned}$$

where $B_1 = b/(1-b)$ and $B_2 = b/(1-b)^2$. Substituting into (12) the expression $\delta = y_t - y_{t-1} - v_t$ derived from (5) and substituting the resulting expression into (3), we get

$$\begin{aligned} D_t^* &= (r\alpha + r\alpha B_1) y_t \\ &\quad + r\alpha B_2 (y_t - y_{t-1}) - r\alpha B_2 v_t \end{aligned}$$

or

$$D_t^* = (1 + B_1 + B_2) r\alpha y_t - B_2 r\alpha y_{t-1} - r\alpha B_2 v_t. \qquad (13)$$

Substituting (13) into (1), we get the following econometric specification of the Rational model:

$$\begin{aligned} \Delta D_t &= a_0 + cr\alpha(1 + B_1 + B_2) y_t - cr\alpha B_2 y_{t-1} \\ &\quad - cD_{t-1} + (u_t - cr\alpha B_2 v_t) \end{aligned}$$

or

$$\Delta D_t = a_0 + a_1 y_t - a_2 y_{t-1} - cD_{t-1} + \xi_t, \qquad (14)$$

where $a_1 = cr\alpha(1 + B_1 + B_2)$, $a_2 = cr\alpha B_2$ and $\xi_t = u_t - cr\alpha B_2 v_t$. The restrictions implied by our rational expectations hypothesis are clear in (14). The coefficient (a_1) of y_t is positive while the coefficient $(-a_2)$ of y_{t-1} is negative. Furthermore (14) indicates that $a_1 > a_2$ and that $(a_2/a_1) = B_2/(1 + B_1 + B_2) = b$. These restrictions may be empirically tested.

Estimated coefficients of (14) using ordinary least squares (OLS) are presented in table 1, with t-statistics in parentheses, for both U.S. and Japanese firms in various industry groups.[6] Data were pooled over firms as well as over years (18 years for the United States and 20 years for Japan) to increase the efficiency of estimation.[7] (Details of the data used and variable definitions are given in the appendix.) The estimation results for the Lintner model are presented for comparison purposes in table 1 in the second row of coefficient estimates given for each industry.

For both U.S. and Japanese firms the coefficients of our current and lagged earnings variables have the signs expected according to our Rational model and are significant in general at conventional levels. We also tested the linear restriction that a_1 (the coefficient of y_t) is greater than a_2 (the negative of the coefficient of y_{t-1}). This hypothesis is accepted for all industry groups for which the coefficient of y_{t-1} is found to be statistically significant. For both the Rational and Lintner models the constant terms are numerically larger and statistically more significant for Japanese firms than for U.S. firms. In fact, one might argue in favor of suppressing the constant terms for U.S. firms (see Fama and Babiak (1968)). On the other hand, our findings for Japanese firms are consistent with Lintner's argument (1956, p. 107) that the constant term is expected to be non-negative and should be present in our econometric specification "to reflect the greater reluctance to reduce than to raise dividends which was commonly observed as well as the influence of the specific desire for a gradual growth in dividend payments found in about a third of the companies visited." Our findings for Japanese firms and Lintner's view about the constant term are also consistent with Wallich and Wallich's (1976, p. 302) observation for Japan that "One aspect of rights issues... has been the policy of paying a dividend that is stable in amount per share over considerable periods... ."[8]

---

[6] Using data from two countries with different institutional settings has been found to be helpful in analyzing economic hypotheses concerning the behavior of firms in, for instance, Nakamura and Nakamura (1981a, 1982).

[7] In other studies where dividend equations were estimated for each firm using about twenty observations per firm, the coefficient of the lagged earnings variable could not be estimated with high efficiency and the t-statistics are often close to zero on the average (for example, see Fama and Babiak (1968) and Watts (1973)). For this reason we use pooled regression in this paper to get more stable and statistically significant estimates.

[8] The significant constant term may also reflect tax policies favoring dividend incomes and payouts of individuals and corporations, respectively (Pechman and Kaizuka (1976, p. 373, p. 377)), as well as increasing numbers of institutional owners of listed companies (Caves and Uekusa (1976, p. 467)) who prefer dividends over capital gains because of the ensuing control over management and because of tax considerations.

TABLE 1.—ESTIMATED COEFFICIENTS FOR THE RATIONAL AND LINTNER MODELS[a] FOR U.S. AND JAPANESE FIRMS IN SELECTED INDUSTRIES

U.S.						Japan					
Industry[b]	Y	Y_{-1}	D_{-1}	Constant	R^2	Industry	Y	Y_{-1}	D_{-1}	Constant	R^2
Food						Food					
	0.151	−0.087	−0.151	−0.018	0.39		0.058	0.001	−0.465	1.76	0.45
	(23.4)	(11.4)	(9.9)	(1.2)			(12.5)	(0.4)	(24.7)	(13.9)	
	0.115		−0.246	0.044	0.30		0.058		−0.462	1.76	0.45
	(19.2)		(18.0)	(2.9)			(13.4)		(27.1)	(13.9)	
Chemicals						Chemicals					
	0.178	−0.118	−0.144	−0.002	0.42		0.142	−0.054	−0.390	0.865	0.41
	(29.8)	(17.1)	(12.9)	(0.2)			(26.3)	(8.6)	(19.9)	(8.9)	
	0.112		−0.238	−0.031	0.30		0.118		−0.477	0.944	0.38
	(22.4)		(22.1)	(2.7)			(25.0)		(27.9)	(9.6)	
Petroleum Refining						Petroleum Refining					
	0.115	−0.060	−0.173	0.032	0.31		0.035	−0.020	−0.175	0.514	0.42
	(13.9)	(6.4)	(7.6)	(1.0)			(8.5)	(4.3)	(4.1)	(2.3)	
	0.086		−0.242	0.006	0.25		0.035		−0.271	0.811	0.35
	(12.1)		(11.6)	(0.2)			(7.9)		(6.9)	(3.7)	
Cement						Cement					
	0.041	0.011	−0.116	−0.023	0.16		0.059	−0.022	−0.180	0.589	0.22
	(4.3)	(1.0)	(5.1)	(0.9)			(10.9)	(3.8)	(8.4)	(3.6)	
	0.047		−0.109	−0.021	0.16		0.048		−0.212	0.622	0.20
	(6.7)		(5.0)	(0.8)			(10.3)		(10.6)	(3.8)	
Machinery and Precision						Machinery and Precision					
	0.129	−0.057	−0.185	−0.015	0.33		0.615	−0.008	−0.868	−6.23	0.93
	(36.3)	(13.1)	(20.6)	(2.3)			(159.4)	(0.6)	(47.9)	(5.1)	
	0.102		−0.248	−0.031	0.29		0.615		−0.879	−6.31	0.92
	(34.3)		(32.0)	(4.6)			(159.7)		(156.8)	(5.2)	
All Machinery						All Machinery					
	0.113	−0.041	−0.189	−0.010	0.33		0.614	−0.013	−0.861	−5.78	0.92
	(39.9)	(11.8)	(24.4)	(1.5)			(185.3)	(1.2)	(55.9)	(6.5)	
	0.094		−0.238	−0.021	0.30		0.164		−0.878	−5.90	0.92
	(39.4)		(35.9)	(3.1)			(185.6)		(182.3)	(6.7)	
Utilities						Utilities					
	0.184	−0.125	−0.123	0.062	0.29		0.209	−0.019	−0.255	−0.452	0.54
	(20.0)	(11.5)	(7.1)	(3.9)			(15.9)	(1.1)	(7.3)	(0.8)	
	0.116		−0.219	0.072	0.20		0.214		−0.286	−0.454	0.53
	(15.5)		(13.6)	(4.3)			(17.3)		(14.0)	(0.8)	
Wholesale/Retail						Wholesale/Retail					
	0.088	−0.031	−0.174	0.006	0.24		0.069	−0.012	−0.361	1.29	0.29
	(18.5)	(5.7)	(14.1)	(0.7)			(13.2)	(2.0)	(13.9)	(8.4)	
	0.072		−0.205	−0.001	0.22		0.065		−0.385	1.32	0.28
	(18.7)		(18.5)	(0.1)			(13.4)		(16.6)	(8.5)	
Service						Service					
	0.123	0.007	−0.516	0.046	0.26		0.054	−0.026	−0.152	0.496	0.19
	(7.0)	(0.39)	(11.4)	(0.9)			(8.4)	(3.7)	(7.4)	(1.8)	
	0.126		−0.510	0.051	0.26		0.037		−0.182	0.551	0.16
	(7.9)		(12.1)	(1.1)			(8.3)		(9.6)	(1.9)	
Computing Machinery						Transportation Machinery					
	0.298	−0.206	−0.191	−0.108	0.63		0.084	−0.047	−0.162	0.394	0.30
	(18.0)	(9.2)	(5.1)	(2.6)			(18.5)	(9.3)	(8.9)	(3.3)	
	0.201		−0.421	−0.200	0.48		0.074		−0.259	0.372	0.24
	(13.4)		(12.9)	(4.3)			(16.2)		(16.6)	(3.0)	
Motor Vehicles						Mining					
	0.105	−0.026	−0.234	0.042	0.36		0.302	−0.148	−0.257	−0.146	0.53
	(12.5)	(2.4)	(8.6)	(1.1)			(9.6)	(3.8)	(4.6)	(0.2)	
	0.094		0.271	0.045	0.35		0.245		−0.398	−0.338	0.45
	(13.3)		(11.9)	(1.2)			(8.3)		(8.9)	(0.5)	
Aircraft						Construction					
	0.082	−0.027	−0.128	−0.033	0.28		0.144	−0.084	−0.340	1.23	0.83
	(12.6)	(3.7)	(6.4)	(1.6)			(50.0)	(14.3)	(10.2)	(7.5)	
	0.070		−0.160	−0.045	0.26		0.131		−0.758	2.80	0.77
	(12.3)		(8.8)	(2.2)			(41.3)		(41.0)	(19.8)	

[a] The first row of estimated coefficients under each industry heading is for the Rational model while the second is for the Lintner model. The numbers in parentheses are t-statistics.

[b] The industry titles used in this and all other tables in this paper are only suggestive. Details are available from the authors. Some of our industry categories are subcategories of other categories. For the United States we give results for All Machinery and for the subcategories of Motor Vehicles, Aircraft, and Machinery and Precision (everything in All Machinery except Motor Vehicles and Aircraft). We also give results for Computing Machinery which is a subcategory of Machinery and Precision. For Japan we give results for All Machinery and for the subcategories of Transportation Machinery, and Machinery and Precision (everything in All Machinery but Transportation Machinery). Because we do not have information for Japan for as many subcategories of All Machinery as for the United States, for Japan we fill out our tables by showing results for the two additional industry categories of Mining and Construction.

Of course, serious doubts can be raised about our inferences based on the results presented in table 1. Three assumptions about the error term of a model must be satisfied in order for the OLS coefficient estimates for the model to be consistent and for traditional tests of significance to be appropriate. The error term must be serially independent (over time and over firms in our case), it must be homoscedastic and it must be independent of the explanatory variables in the model. In addition, the parameters of the model must be constants (for all time periods and all firms represented in the data base in our case). Firm and time specific coefficients can always be rewritten, though, as sums of common parameters plus firm and time specific deviation terms.[9] Thus the last of these four assumptions can always be restated in terms of the first three on which we will concentrate in the following discussion.

On a priori grounds it seems unlikely that these three assumptions would be *precisely* satisfied for either the Rational or Lintner model *even if we used time series data for a single firm*. For instance, neither model controls directly for changes in macroeconomic conditions or expectations. There may be errors-in-variables or misspecification of the functional form of a model. As the Rational model is stated in this paper, it is clear too from equations (5) and (14) that there is a correlation problem between the current earnings per share variable and the error term for the model. (Nor are good instruments for the earnings variable readily available.) If estimation is carried out firm by firm, the problem of drawing conclusions about the common elements of firm behavior must still be solved if general or comparative questions concerning firm behavior are to be addressed. An alternative approach is to use data pooled over firms as well as time periods, as in this study. In this case, however, the departures from the three assumptions of interest are likely to be even more serious. The question before us is whether the violations of these assumptions *which presumably are present* are serious enough to call into question the qualitative findings of the empirical portion of this paper.

This is a question that cannot be appropriately addressed using traditional specification error tests, which are tests of the *existence* of specific specification error problems. In general, neither these tests nor the test statistics for these tests are appropriate measures of the *extent* of the departure from the stated null hypothesis, or of the *consequences* of this departure.[10]

The replication of our key qualitative results for 12 industry groups for the United States and 12 industry groups for Japan gives us some confidence in these results. Predictive comparisons can also be used to further explore the soundness of these findings.[11] Our predictive comparisons are for both in-sample and out-of-sample time periods. The *in-sample* period for each country is the period spanned by the data used in obtaining the estimation results shown in table 1 (1964–81 for the United States and 1961–80 for Japan). Our simulation time period for each country extends one year beyond the respective in-sample period. Results for the last year of the simulation period are referred to as *out-of-sample* results.

In the first simulation year we calculate the expected change in the dividend payout ($\Delta D_1 = D_1 - D_0$) for each firm in each industry-country group, for both the Rational and Lintner models, using the appropriate set of coefficient estimates from table 1 and the *actual* values of all explanatory variables. Simulated dividend payouts for this first year are then obtained by adding the expected change to the corresponding actual dividend payout for each firm for the year preceding the first simulation year. The simulation proceeds in a similar manner in successive years, except that after the first year the *simulated* rather than the actual value of the lagged dividend variable is used in calculating the expected change in the dividend payout, and then is added to this expected change to obtain the current simulated value of the dividend payout for the given firm and model. Systematic prediction errors will thus cause the simulated values for the dividend payouts for a firm to depart farther and farther from the actual values over the course of a long simulation period.

---

[9] If the firm and time specific parameters of a model share no common elements, OLS estimates of these common elements will be of no interest.

[10] See Nakamura and Nakamura (1984) for a more specific discussion of this question in the context of a particular specification error test proposed by Wu and Hausman. See, for example, Nakamura and Nakamura (1981b) for these tests and their relationships.

[11] See Nakamura and Nakamura (1985) for an elaboration of this approach to model choice and specification analysis.

TABLE 2.—PREDICTIVE COMPARISONS OF THE RATIONAL AND LINTNER MODELS

United States			Japan		
Industry	In-Sample[a] R_I^2	Out-of-Sample[b] R_I^2	Industry	In-Sample R_I^2	Out-of-Sample R_I^2
Food			Food		
	.26	.09		.03	.28
	.07	.03		.02	.27
Chemicals			Chemicals		
	.48	.15		.01	.01
	.20	.05		.00	.01
Petroleum Refining			Petroleum Refining		
	.05	.05		.05	.76
	.00	.03		.06	.70
Cement			Cement		
	.44	.14		.00	.12
	.45	.15		.00	.14
Machinery and Precision			Machinery and Precision		
	.38	.14		.54	.03
	.25	.10		.53	.03
All Machinery			All Machinery		
	.32	.08		.53	.04
	.21	.05		.52	.03
Utilities			Utilities		
	.35	.01		.50	.04
	.18	.00		.48	.03
Wholesale/Retail			Wholesale/Retail		
	.22	.01		.01	.40
	.16	.00		.00	.38
Service			Service		
	.08	.23		.06	.09
	.08	.23		.02	.08
Computing Machinery			Transportation Machinery		
	.57	.36		.05	.49
	.31	.16		.00	.37
Motor Vehicles			Mining		
	.14	.00		.70	.18
	.09	.00		.46	.04
Aircraft			Construction		
	.26	.02		.37	.34
	.17	.00		.10	.05

[a] R_I^2 denotes the R^2 of the regression of the predicted dividends on true dividends. The R^2s for the Rational model are given in the first row while the R^2s for the Lintner model are given in the second row for each industry group. In-sample R^2s were derived from applying the models to the sample from which coefficients reported in table 1 were estimated. The sizes of such samples are given in table A1 as numbers of pooled observations. Years covered are 1964–81 (18 years) for the United States and 1961–80 (20 years) for Japan.

[b] Out-of-Sample R^2s were derived from applying the models to the observations for 1982 (for the United States) and for 1981 (for Japan) which were not included in the samples used for the estimation. The number of observations for this out-of-sample regression is the number of firms in each industry given in table A1.

The values of R_I^2 shown in table 2 are the squared correlations of the simulated and actual values of the current dividend payout variable (D) for the designated in-sample and out-of-sample time periods. (The second row of numbers for each industry gives values for the Lintner model.) From table 2 we find that the in-sample as well as the out-of-sample values for R_I^2 are as high or higher for the Rational model than for the Lintner model for 11 out of our 12 industry groups for both the United States and Japan. On the basis of these results we conclude that the Rational model yields somewhat better predictions of the dividend payouts of firms, and that the Rational model probably captures aspects of the dividend behavior of firms that are ignored by the Lintner model. Concerns that the biases in our estimated coefficients may vitiate our qualitative findings can be explored through further simulation checks. For instance, if the bias problems are not the same for the Rational and Lintner models or for all firms in our industry-country subgroups, we might expect that a symptom of serious bias problems would be that the Rational model would be found to per-

TABLE 3.—PREDICTIVE POWER TESTS OF POOLING AND ENDOGENEITY

	United States									Japan							
	Pooling				Endogeneity					Pooling				Endogeneity			
	In-sample		Out-of-sample		In-sample		Out-of-sample			In-sample		Out-of-sample		In-sample		Out-of-sample	
Subgroup	1	2	1	2	1	2	1	2		1	2	1	2	1	2	1	2
Food (38, 15; 23, 30)[a]									Food (21, 26; 23, 24)								
	.23	.25	.04	.21	.21	.25	.09	.10		.00	.08	.28	.25	.01	.18	.42	.08
	.04	.15	.00	.25	.03	.10	.02	.03		.00	.07	.28	.25	.01	.18	.42	.08
Chemicals (58, 19; 27, 50)									Chemicals (17, 59; 32, 44)								
	.19	.86	.02	.83	.40	.56	.08	.18		.10	.01	.11	.02	.07	.00	.13	.07
	.04	.58	.00	.60	.10	.32	.01	.11		.12	.00	.13	.01	.06	.00	.15	.06
Petroleum Refining (24, 5; 12, 17)									Petroleum Refining (3, 5; 4, 4)								
	.08	.14	.03	.02	.02	.11	.27	.01		.01	.07	—[b]	.83	.09	.01	.69	.82
	.00	.10	.02	.00	.00	.03	.22	.00		.00	.09	—	.80	.12	.00	.65	.79
Cement (5, 10; 6, 9)									Cement (6, 25; 17, 14)								
	.13	.54	.63	.28	.53	.38	.21	.10		.04	.00	.43	.12	.30	.06	.47	.00
	.13	.55	.64	.28	.55	.38	.23	.09		.06	.00	.30	.15	.27	.06	.51	.00
Machinery and Precision (119, 58; 72, 105)									Machinery and Precision (31, 101; 60, 72)								
	.49	.26	.12	.13	.38	.39	.08	.27		.93	.09	.04	.03	.56	.19	.01	.18
	.29	.14	.07	.14	.25	.26	.03	.25		.93	.08	.04	.03	.55	.18	.01	.18
All Machinery (149, 77; 92, 134)									All Machinery (31, 101; 60, 72)								
	.30	.36	.05	.13	.33	.30	.01	.18		.92	.09	.04	.04	.55	.14	.02	.20
	.17	.29	.02	.12	.21	.21	.00	.16		.91	.08	.04	.04	.54	.13	.02	.19
Utilities (44, 12; 32, 24)									Utilities (3, 11; 9, 5)								
	.34	.34	.01	.22	.16	.50	.02	.10		.45	.87	—	.92	.78	.84	.98	.87
	.18	.15	.01	.07	.03	.37	.07	.04		.43	.84	—	.89	.73	.81	.96	.84
Wholesale/Retail (62, 21; 31, 52)									Wholesale/Retail (56, 18; 23, 8)								
	.18	.30	.00	.08	.13	.27	.01	.03		.00	.03	.34	.25	.13	.02	.10	.01
	.13	.23	.00	.05	.08	.21	.01	.02		.00	.03	.32	.23	.13	.02	.10	.01
Service (21, 4; 7, 18)									Service (8, 16; 15, 9)								
	.09	.04	.27	.01	.22	.06	.46	.17		.02	.10	.01	.26	.06	.27	.18	.01
	.09	.03	.27	.01	.21	.05	.47	.17		.00	.06	.00	.27	.02	.24	.18	.02
Computing Machinery (11, 1; 3, 9)									Transportation Machinery (12, 38; 25, 25)								
	.58	.84	.28	—	.87	.43	—	.52		.60	.05	.12	.66	.49	.15	.14	.91
	.30	.84	.09	—	.70	.25	—	.35		.44	.05	.13	.46	.27	.21	.08	.85
Motor Vehicles (12, 10; 8, 14)									Mining (1, 4; 2, 3)								
	.04	.57	.30	.33	.11	.15	.33	.22		.70	.72	—	.03	.45	.72	—	—
	.09	.57	.31	.33	.06	.10	.36	.21		.54	.48	—	.03	.28	.45	—	—
Aircraft (18, 9; 12, 15)									Construction (8, 21; 16, 13)								
	.34	.14	.10	.00	.34	.20	.16	.01		.90	.16	.95	.02	.37	.06	.33	.01
	.26	.10	.05	.00	.21	.13	.08	.01		.68	.03	.74	.06	.11	.01	.05	.03

[a] The industry name is followed in each case by the numbers of *firms* in the subsamples 1 and 2 for which results are reported under the "Pooling" heading, and then by the numbers of *firms* in the subsamples 1 and 2 for which results are reported under the "Endogeneity" heading for the given country. The number of observations used in computing a given value for R_1^2 is thus the number of firms in the appropriate subgroup multiplied by the number of years of in-sample (18 years for the United States, 20 for Japan) or out-of-sample data (1 year for each country).

[b] A dash indicates too few observations (< 5) to compute a meaningful value for R_1^2.

form *less* well in a predictive sense than the Lintner model for certain subgroups of the firms in our industry-country groups.

Concerns have been raised about the pooling of observations over firms with different patterns of growth for earnings per share (y).[12] We split the firms in each of our industry-country groups according to the following rule. Subgroup 1 consists of firms in the given industry-country group that experienced increases in earnings per share (that is, $\Delta y = y - y_{-1} > 0$) for 60% or more of the in-sample years. Subgroup 2 consists of the remaining firms. Separate values of R_1^2 were calculated for each model using both in-sample and out-of-sample data for these two subgroups of firms within each of our industry-country groups. These values as well as the numbers of firms in our subgroups are shown in table 3 under the "Pool-

---

[12] We could be concerned about such a "pooling problem," of course, even if we were not using data pooled over firms, since a single firm can experience periods of growth as well as periods of decline in earnings per share.

ing" heading. According to our R_1^2 criterion the Rational model outperforms the Lintner model for both these subgroups of firms.

Or suppose we are concerned about coefficient bias problems due to the correlation in the Rational model between the current earnings per share variable and the error term for the model. Coefficient bias will be helpful in prediction for any firm where this bias properly reflects the direct as well as the proxy effects of the explanatory variable in question. If the bias in an estimated coefficient does not properly reflect the proxy effects of an explanatory variable for a given firm in some industry-country group, however, this will lead to systematic prediction errors, with the errors in any one year over the course of the simulation leading to errors in subsequent years as well because of the design of the simulation. Moreover, the larger the magnitudes are of the explanatory variable in question for the given firm, the larger the magnitudes of the resulting errors in prediction are likely to be. Thus one might expect problems of bias in our coefficient estimates for the Rational model to be particularly evident in our simulation results for those firms in an industry-country group with larger values of our earnings per share variable.

We calculated separate values of R_1^2 for each model using both in-sample and out-of-sample data for the subgroups of firms with larger versus smaller values of the earnings per share variable. Subgroup 1 consists of firms with earnings per share in the tenth in-sample year (y_{10}) that were greater than the average in that year for the corresponding 4-digit industry group. Subgroup 2 consists of the remaining firms. The values of R_1^2 for these subgroups, as well as the numbers of firms in these subgroups, are shown in table 3 under the heading of "Endogeneity." Looking at the in-sample results under the endogeneity heading, the Rational model seems to outperform the Lintner model. A similar conclusion emerges from the out-of-sample results for Japan and for the U.S. firms in our lower earnings subgroups. For the U.S. firms in our higher earnings subgroups, however, the out-of-sample values of R_1^2 for the Lintner model are somewhat higher than the corresponding values for the Rational model for 4 out of the 11 industry groups for which there are enough firms in the higher earnings subgroup to calculate meaningful values for the statistic. Nevertheless, we find no evidence in table 3 of a serious bias problem in our results for Japan, and the qualitative findings of this study are the same for the United States as for Japan.

III. Conclusions

We have derived, under a rational expectations hypothesis for a firm's management, an econometric specification of the firm's dividend behavior. This specification results in the inclusion of a lagged earnings variable in the Lintner model, and provides empirically testable sign and magnitude restrictions on the estimated coefficients of the resulting model of dividend behavior. This model has been estimated using data for U.S. and Japanese firms, and these restrictions have been found to be confirmed empirically. Using simulation methods the Rational model has also been found to predict dividends paid out somewhat better in most cases than the Lintner model.

REFERENCES

Ball, Ray, and Ross Watts, "Some Time-Series Properties of Accounting Income Numbers," *Journal of Finance* 27 (June 1972), 663–682.

Caves, Richard E., and Masu Uekusa, "Industrial Organization," in Hugh Patrick and Henry Rosovsky (eds.), *Asia's New Giant: How the Japanese Economy Works* (Washington, D.C.: Brookings Institution, 1976), 459–526.

Cinlar, Erhan, *Introduction to Stochastic Processes* (Englewood Cliffs, N.J.: Prentice-Hall, 1975).

Duesenberry, James S., *Business Cycles and Economic Growth* (New York: McGraw-Hill, 1958).

Fama, Eugene F., "The Empirical Relationships between the Dividend and Investment Decisions of Firms," *American Economic Review* 64 (June 1974), 304–318.

Fama, Eugene F., and Harvey Babiak, "Dividend Policy: An Empirical Analysis," *Journal of the American Statistical Association* 63 (Dec. 1968), 1132–1161.

Flavin, Marjorie A., "The Adjustment of Consumption to Changing Expectations About Future Income," *Journal of Political Economy* 89 (Oct. 1981), 974–1009.

Gonedes, Nicholas J., "Properties of Accounting Numbers: Models and Tests," *Journal of Accounting Research* 11 (Spring 1973), 212–237.

Jalilvand, Abolhassan, and Robert S. Harris, "Corporate Behavior in Adjusting to Capital Structure and Dividend Targets: An Econometric Study," *Journal of Finance* 39 (Mar. 1984), 127–145.

Japan Development Bank, *Handbook of Financial Data of Industries*, Tokyo, 1982.

Lintner, John, "Distribution of Incomes of Corporations among Dividends, Retained Earnings and Taxes," *American Economic Review* 46 (Mar. 1956), 97–113.

Mayer, Thomas, James S. Duesenberry and Robert Z. Aliber, *Money, Banking and the Economy*, 2nd edition (New York: W. B. W. Norton, 1984).

Nakamura, Alice, and Masao Nakamura, "Valuation, Debt Financing and the Cost of Capital: Japanese Firms, 1962–1976," *Economic Studies Quarterly* (Aug. 1981a), 97–110.

______, "On the Relationships among Several Specification Error Tests Presented by Durbin, Wu and Hausman," *Econometrica* 49 (Nov. 1981b), 1583–1588.

______, "Production, Capital Structure and Demand for Debt," this REVIEW 64 (Aug. 1982), 384–393.

______, "On the Performance of Tests by Wu and by Hausman for Detecting the Ordinary Least Squares Bias Problem," paper presented at the Econometric Society Meetings in San Francisco, Dec. 1983; revised 1985; forthcoming in the *Journal of Econometrics.*

______, *The Second Paycheck: A Socioeconomic Analysis of Earnings* (New York: Academic Press, 1985).

Pechman, Joseph A., and Keimel Kaizuka, "Taxation," in Hugh Patrick and Henry Rosovsky (eds.), *Asia's New Giant: How the Japanese Economy Works* (Washington, D.C.: Brookings Institution, 1976), 317–382.

Wallich, Henry C., and Mable I. Wallich, "Banking and Finance," in Hugh Patrick and Henry Rosovsky (eds.), *Asia's New Giant: How the Japanese Economy Works* (Washington, D.C.: Brookings Institution, 1976), 249–315.

Watts, Ross, "The Information Content of Dividends," *Journal of Business* 46 (Apr. 1973), 191–211.

Watts, Ross, and Richard W. Leftwich, "The Time Series of Annual Accounting Earnings," *Journal of Accounting Research* 15 (Autumn 1977), 253–271.

APPENDIX

Data and Variable Definitions

We used the Cumpustat tape (1964–1982) to create a data base for U.S. firms. We eliminated those firms which either do not have relevant variables or which did not pay dividends all through the period of 1963–1982. The dividends and earnings were both measured on a per share basis. The information regarding the payout ratios of these firms in the pooled sample, as well as the numbers of firms, are given in table A1. We tried a variety of definitions of earnings per share. Since they all provided similar results, we report results using earnings per share excluding extraordinary items and discontinued operations. Both dividends and earnings per share were adjusted for stock splits and stock dividends. A similar data base was made for Japanese firms (1960–1981) from the Japan Development Bank data base which includes information for all firms listed on both the Tokyo and Osaka Stock Exchanges. It is seen from table A1 that the payout ratios are quite stable and similar for both U.S. and Japanese firms over these years. The payout ratios for Japanese firms are seen to have slightly higher standard deviations, in general, than those for U.S. firms, both on a pooled (S.D.1) and a firm-specific (S.D.2) basis. The industry titles used in tables 1–3 and table A1 are only suggestive. The details of the firms included in our industry groups are available on request from the authors.

TABLE A1.—MEANS AND STANDARD DEVIATIONS OF DIVIDEND PAYOUT RATIOS FOR U.S. AND JAPANESE FIRMS BY INDUSTRY[a]

United States			Japan		
Industry	Payout Ratio (S.D.1, S.D.2)[b]	No. of Firms (No. of Pooled Observations)	Industry	Payout Ratio (S.D.1, S.D.2)	No. of Firms (No. of Pooled Observations)
Food			Food		
	.40	53		.48	47
	(.22,.14)	(954)		(.25,.19)	(940)
Chemicals			Chemicals		
	.40	77		.47	76
	(.21,.13)	(1386)		(.30,.24)	(1520)
Petroleum Refining			Petroleum Refining		
	.36	29		.44	8
	(.19,.13)	(522)		(.33,.31)	(160)
Cement			Cement		
	.43	15		.46	31
	(.31,.24)	(270)		(.29,.26)	(620)
Machinery[c] and Precision			Machinery and Precision		
	.32	177		.43	132
	(.23,.15)	(3186)		(.27,.24)	(2640)
All Machinery[d]			All Machinery		
	.33	226		.43	182
	(.24,.16)	(4068)		(.27,.23)	(3640)
Utilities			Utilities		
	.64	56		.74	14
	(.15,.11)	(1008)		(.23,.21)	(280)
Wholesale/Retail			Wholesale/Retail		
	.31	83		.45	41
	(.22,.14)	(1494)		(.26,.22)	(820)

TABLE A1.—*Continued*

United States			Japan		
Industry	Payout Ratio (S.D.1, S.D.2)[b]	No. of Firms (No. of Pooled Observations)	Industry	Payout Ratio (S.D.1, S.D.2)	No. of Firms (No. of Pooled Observations)
Service	.25 (.24, .14)	25 (450)	Service	.44 (.29, .22)	24 (480)
Computing Machinery	.33 (.23, .15)	12 (216)	Transportation Machinery	.43 (.26, .22)	50 (1000)
Motor Vehicles	.38 (.26, .22)	22 (396)	Mining	.31 (.38, .35)	5 (100)
Aircraft	.33 (.23, .18)	27 (486)	Construction	.46 (.22, .18)	29 (580)

[a] See the text in the appendix for the sources of data

[b] S.D.1 is the standard deviation of the pooled data while S.D.2 is the mean of the standard deviations calculated for the firms in the sample. Let p_{it} = the payout ratio for the i^{th} firm in year t, where $i = 1, 2, \ldots, N$ and $t = 1, 2, \ldots, T$, and let

$$p_i = (1/T)\sum_{t=1}^{T} p_{it}$$

and

$$p = (1/NT)\sum_{i=1}^{N}\sum_{t=1}^{T} p_{it}.$$

Then

$$\text{S.D.1} = \left(\sum_{i=1}^{N}\sum_{t=1}^{T}(p_{it} - p)^2/(NT-1)\right)^{1/2}$$

and

$$\text{S.D.2} = \left((1/N)\sum_{i=1}^{N}\left(\sum_{t=1}^{T}(p_{it} - p_i)^2/(T-1)\right)^{1/2}\right)$$

[c] This includes Industrial, Computing and Electrical Machinery

[d] This includes Industrial, Computing and Electrical Machinery, Precision, Motor Vehicles and Aircraft