Dividends and Investment: Further Empirical Evidence

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This study further examines the relationship between corporate dividend and investment policies. Under Modigliani-Miller perfect capital market assumptions, these policies should be independent, but previous research finds conflicting results. Independence claims have been made based on Granger causality tests with 20 year time series. When we construct simulated series with a strong dependency between dividends and investment, however, causality tests are unable to detect it. We obtain a sample consisting of firms for which 37 years of data are available. Granger causality in the direction from dividends to investment is found in approximately 33 percent of these firms. This finding complements survey results showing dividends are given priority in some firms, a dependency that violates the separation principle.

INTRODUCTION

Assuming perfect capital markets, Miller and Modigliani (1961) demonstrate that the value of the firm depends only on investment policy and not on the method of financing investments. Thus, although we would expect higher investment to lead to higher dividends over time, we should not find an intertemporal relationship in the direction from dividends to investment. Fama and Miller (1972) refer to this effect as the *separation principle*. A finding that dividend policy influences investment would imply that either suboptimal investment choices are being made or that market imperfections exist which make it optimal for firms to operate in this manner. Tests of the separation principle therefore are linked crucially to the question of how dividend policy affects the value of the firm.

Several studies have tested the empirical validity of the separation principle, but data and methodological problems have prevented an effective resolution of this issue. Dhrymes and Kurz (1967) and Partington (1985) find dependencies that violate the separation principle. Fama (1974), Smirlock and Marshall (1983), and Pruitt and Gitman (1991) find independence between dividends and investment. We show that the conflict is due in part to insufficiently long time series that preclude the detection of dependencies. We resolve this by extending the length of the series using data that were not available when previous empirical studies were performed.

PREVIOUS WORK

Since Miller and Modigliani (1961) proposed that investment and financing decisions are independent in perfect capital markets, there have been many attempts to test the empirical validity of this principle. Some of the significant early work in this area was performed by Dhrymes and Kurz (1967) and Fama (1974). The conclusions of these two

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studies, however, differ radically. Dhrymes and Kurz develop a theoretical model consisting of three simultaneous equations representing the dividend, investment, and external financing decisions. They find evidence of bidirectional causality between dividends and investment. Fama rejects both the methodology and the conclusions of Dhrymes and Kurz, claiming that their structural assumptions bias the findings. His results support the hypothesis that dividend and investment decisions are determined independently. Fama concludes that whatever imperfections are present in the capital markets are not sufficient to reject the independence hypothesis.

In a more recent study, Smirlock and Marshall (1983) use Granger (1969, 1980) causality methods to test for causal relationships between dividends and investment. If symmetric lag lengths are assumed, this methodology is operationalized best as a vector autoregression (VAR). The two lag specification of the bivariate model can be stated in VAR form as follows:

$$(1)\ Y_t = \Lambda + \theta_1 Y_{t-1} + \theta_2 Y_{t-2} + \zeta_t$$

where:

$$Y_t = \begin{bmatrix} INV_t \\ DIV_t \end{bmatrix} \quad \Lambda = \begin{bmatrix} \alpha_0 \\ \gamma_0 \end{bmatrix} \quad \theta_i = \begin{bmatrix} \alpha_i & \beta_i \\ \delta_i & \gamma_i \end{bmatrix} \quad \zeta_t = \begin{bmatrix} \varepsilon_t \\ \mu_t \end{bmatrix}.$$

This reduces to the following two regression equations:

$$(2)\ INV_t = \alpha_0 + \sum_{i=1}^{2} \alpha_i INV_{t-i} + \sum_{j=1}^{2} \beta_j DIV_{t-j} + \varepsilon_t$$

$$(3)\ DIV_t = \gamma_0 + \sum_{j=1}^{2} \gamma_j DIV_{t-j} + \sum_{i=1}^{2} \delta_i INV_{t-i} + \mu_t$$

Testing for Granger causality involves performing block F-tests for the significance of the β coefficients in equation (2) and the δ coefficients in equation (3).

The two lag specification of the model is appropriate both on the grounds of theory and of data availability. The relationship being tested is one that theoretically should not exist at all; if it does exist, it may be largely contemporaneous. Therefore, two lags of the annual data series should be sufficient to detect any causal relationship. Furthermore, the 20 year data series used by Smirlock and Marshall are extremely short for time series work, so increasing the number of lags in the model is not a viable alternative.

Smirlock and Marshall conduct Granger causality tests on both firm-specific and aggregate data. Aggregate data are obtained by summing the dividend and investment variables across the firms in the sample for each year. Causality tests are performed by estimating equations (2) and (3) on the individual firm series and on the aggregate series. Table 1 shows their results for block exclusion tests of dividends from equation (2) and

Table 1—Granger Causality F-Statistics from Smirlock and Marshall

Critical Values: $F_{\alpha=0.05,\, df=2,12} = 3.81$, $F_{\alpha=0.10,\, df=2,12} = 2.76$

Panel A: Firm-Specific Tests

Percentile	Dividends	Investment
10	0.05	0.04
25	0.18	0.12
50	0.59	0.39
75	1.22	1.07
90	2.19	2.04

Panel B: Aggregate Tests	Dividends	Investment
	0.32	0.04

The columns labeled "Dividends" show F-statistics from block exclusion tests on lagged dividends in the investment equation (2). The "Investment" columns show similar tests on lagged investment in the dividend equation

investment from equation (3). They find no statistically significant evidence of Granger causality in either direction.

There are some important questions, however, that remain unanswered. First, the shortness of the series and the consequent low number of degrees of freedom suggest that these tests may lack discriminatory power. We address this issue by means of simulations. Smirlock and Marshall did not detect what we might expect on the basis of theory (that is, causality in the direction from investment to dividends), so perhaps the methodology is unable to detect causality in either direction. This calls into question their assertion that the results "provide strong support for the view that the firm's dividend and investment decisions are separable." Another obstacle is the possibility of dividend-investment dependency that is strictly contemporaneous within the context of the temporal screen. As acknowledged by Smirlock and Marshall, Granger causality tests cannot detect such relations.

Partington (1985) examines the question of potential dividend-investment causality by surveying senior managers of 152 large Australian firms; 93 responses were obtained. The survey is structured to elicit information relating not only to the frequency and circumstances of different dividend, investment, and financing policies, but also the motivations behind them. Thirty-nine percent of the executives responding said there were times when dividends were given priority and some restrictions were applied to investment spending. Partington concludes that for a significant minority of firms, perceived conflicts exist between dividend and investment policy.

More recently Pruitt and Gitman (1991) conducted a survey of 114 firms drawn from the 1000 largest U.S. firms. They conclude that "over 90 percent of the respondents did not believe that the dividend policies selected by their firms influenced current corporate investment activity." This is consistent with the Smirlock and Marshall independence results.

As with other survey-based investigations, behavioral factors may affect the responses. Furthermore, the two studies cited above draw conclusions from small samples in different countries. These considerations may explain why the results are contradictory.

Even if a majority of managers believe that investment is constrained by dividend policy, statistical relationships in short time series could appear to provide counter evidence. The next section demonstrates through simulations that a wholly dependent dividend-generating process can produce causality test results indistinguishable from those of Smirlock and Marshall. Thus, the question of objective evidence on the relationship between dividends and investment is unresolved by previous research. In this study we address the issue by updating and extending the work of Smirlock and Marshall using longer time series.

SIMULATED DIVIDENDS AND INVESTMENT

The objective of our simulations is to determine whether a causal relationship between dividends and investment can be identified in a series consisting of only 20 observations. For constructing this simulation, the Lintner (1956) model of dividend policy offers some attractive features. Lintner found that dividends were set based on a partial adjustment to each year's target payout. Dividends are always chosen first, with investment determined residually. This constitutes the most extreme case of a causal relationship in the direction from dividends to investment. If Granger causality methods cannot detect this causal relationship in series of length 20, their usefulness in detecting weaker relationships between series of this length is suspect.

Apart from the extreme dependency to be imposed between dividends and investment, it is important that the series be simulated along plausible lines. That is to say, the behavior of the series should have some empirical support. One straightforward model that meets this requirement is suggested by Fama and Babiak (1968). Fama and Babiak begin with the following model:

$$(4)\ D_t - D_{t-1} = \alpha + \beta_1 D_{t-1} + \beta_2 E_t + \beta_3 A_t + u_t$$

where:

D_t = Dividends per share during year t;
E_t = Earnings per share during year t;
A_t = Depreciation per share during year t; and
u_t = A random disturbance term.

$$(5)\ D_t - D_{t-1} = -0.45 D_{t-1} + 0.15 E_t + u_t$$

$$(6)\ u_t = 0.2 u_{t-1} + v_t$$

where:

v_t = A random disturbance term.

While Fama and Babiak simulate earnings as an AR(1) series, a more fundamental approach is taken here. We generate earnings E_t from the following relationships:

(7) $E_t = r_t K_{t-1}$

(8) $I_t = E_t - D_t$

(9) $K_t = K_{t-1}(1 - \delta) + I_t$

where:

K_t = Capital at time t; $K_0 = 20$;
r_t = ROA at time t; distributed N(10%,25%);
D_t = Total dividends during year t, determined from (5); $D_0 = 0.05$, and $D_t \geq 0.05$;
I_t = Investment at time t; and
δ = Depreciation at time t; $\delta = 5\%$.

The key relationship is contained in equation (8), which specifies that in each period investment is the residual of earnings after dividends have been determined. Equations (7) and (9) form the dynamic link between observations in the simulated time series. Our objective is to provide a set of relationships that allow for a credible simulation of the dividend and investment series, while avoiding complexity that could introduce confounding factors. In this simulation model we have constructed a case where investment is determined as a residual item only. This is a violation of the separation principle. While the contemporary portion of the relationship cannot be detected by a Granger causality test, there is another relationship implicit in the above equations. Dividends affect investment which in turn affects next year's capital. Next year's capital produces the earnings from which next year's dividends are paid. Thus, the Lintner model implies an underlying intertemporal causal relationship. Because this relationship is noncontemporaneous, we can expect to identify it by means of a causality test, given sufficient data. Also, because investment is determined completely, rather than only partially, by dividends, this is the strongest form of such a dependency. The series generated by the simulation therefore can be utilized to test the ability of Smirlock and Marshall's methodology to detect a strong violation of the separation principle.

SIMULATION RESULTS

The above model was simulated with series length set at 20 to match Smirlock and Marshall and with number of experiments n = 10,000. Nine simulations initially were run using three values 0.001, 0.01, and 0.1 for $\sigma^2(v_t)$, and three values 0.10, 0.15, and 0.20 for the coefficient on the earnings variable E_t in equation (5). In order to achieve stationarity it was necessary to take log first differences of the dividend series and first differences of the investment series.[1] Following Smirlock and Marshall, tests for a relationship

[1] The augmented Dickey-Fuller test was used to confirm the stationarity of the series. This is essentially the test suggested by Dickey and Fuller (1979, p. 431), but without the time trend term. The tables in Fuller (1976) and Schmidt (1990) only provide critical values for selected sample sizes. The changes in critical value from sample size T to T-1 become more pronounced, however, as T declines, making interpolation difficult. This difficulty was resolved using a Monte Carlo simulation routine that produces critical values for any sample size. We thank Peter Schmidt for providing this routine.

Table 2—Simulated Dividends and Investment, T=20, F-Statistics from Granger Causality Tests

Critical Values: $F_{\alpha=0.05,\ df=2,12} = 3.81$, $F_{\alpha=0.10,\ df=2,12} = 2.76$

Panel A: $\sigma^2(v_t) = 0.001$ coefficient of earnings = 0.10

Percentile	Dividends	Investment
5	0.018	0.148
10	0.038	0.232
25	0.108	0.440
50	0.269	0.740
75	0.589	1.163
90	1.049	1.701
95	1.440	2.129

Panel B: $\sigma^2(v_t) = 0.010$, coefficient of earnings = 0.15

Percentile	Dividends	Investment
5	0.025	0.099
10	0.052	0.189
25	0.142	0.419
50	0.368	0.823
75	0.765	1.413
90	1.352	2.204
95	1.912	2.824*

Panel C: $\sigma^2(v_t) = 0.100$, coefficient of earnings = 0.20

Percentile	Dividends	Investment
5	0.057	0.047
10	0.120	0.094
25	0.317	0.259
50	0.764	0.620
75	1.574	1.304
90	2.737	2.334
95	3.747*	3.198*

* Significant at the 0.10 level

between dividends and investment are conducted using Granger causality methodology. Selected percentiles of the resulting F-statistics are presented in Table 2.[2]

The F-statistics are generally insignificant for all values of the earnings coefficient and $\sigma^2(v_t)$ covered by the simulation. Panel A in Table 2 shows results from the smallest values of the two parameters. Intermediate values are used for Panel B, and the largest values are used for Panel C. The discriminatory power of the test is related positively to both the earnings coefficient and $\sigma^2(v_t)$, because the dividend F-statistics (i.e., from block exclusion tests on lagged dividends in the investment equation) increase with higher parameter values. Even in Panel C, however, we find significance no more often than would be expected by chance. These results demonstrate that a causal relationship of the Lintner type cannot be identified in series of length 20.

[2] Table 2 contains results from three representative cases of the initial nine simulations. The remaining results are available from the authors upon request.

Further simulation runs include a range of values of the autocorrelation coefficient, –0.2 and 0.0 as well as the original value of 0.2 in equation (6).[3] This had no effect for $\sigma^2(v_t)$ values of .001 or .01. When $\sigma^2(v_t)=.1$, lowering the autocorrelation produces small decreases in the dividend F-statistics and small increases in the investment F-statistics. We conclude that the results shown earlier are robust to these changed assumptions.

EMPIRICAL TESTS FOR DIVIDEND-INVESTMENT CAUSALITY

We now turn to tests for dividend-investment causality in data from the Compustat database. Our sample consists of firms for which both dividends and the ending balance of the property, plant, and equipment account are reported for every year during the interval 1952-1989. Data from the Compustat back data files are used to extend the time span beyond the usual 20 years.

Screens are implemented to exclude banks, utilities, insurance companies, limited partnerships, and real estate investment trusts. For these excluded firms, the regulatory environment tends to make dividends particularly sticky. The dividend series are the amount of common stock dividends paid in each year. Because several significant changes in the sources and uses of funds disclosures required by the Financial Accounting Standards Board occurred during the sample period, consistent investment data are not readily available. Two simple proxies for investment are constructed by differencing the ending balances of both gross and net property, plant, and equipment accounts. This reduces the length of the series to 37 years covering 1953-1989.

We follow the Smirlock and Marshall (1983) approach using our significantly longer data series. Smirlock and Marshall required firms to have strictly positive dividends and investment in every year,[4] but less than 35 firms meet these criteria for our 37 year period. To increase the sample size we relax the screening restrictions to allow for firms that had negative or zero investment and zero dividends in up to two years. This results in a sample of 204 firms for the gross investment series and 212 firms for the net investment series, for which there were no missing observations between 1953 and 1989.[5]

Causality tests initially are performed on the raw series, i.e., levels of the variables instead of changes. Some indications of causal relationships are found. These results may be spurious, however, due to nonstationarity in the raw dividend series. For the majority of the sample the raw investment series are stationary but the dividend series are not.

The first differences of these series are stationary for most firms. Table 3 presents causality and stationarity test statistics for the differenced series. The key results are in the columns labeled "dividends," showing F-statistics for the significance of lagged dividends in equation (2). These F-statistics are significant at the $\alpha = 0.05$ level for the 75th percentile, indicating at least 25 percent of the firms show causality in the direction from

[3] Tables are available from the authors upon request.

[4] They required positive values in order to use log differencing transformations on both dividend and investment series.

[5] We repeated our tests with different screening restrictions on dividends. Requiring positive dividends in every year reduces the sample size to 186 firms for gross investment and 192 for net investment. Allowing zero dividends in up to five years increases these sample sizes to 221 and 230. Test results are almost identical to those described later in this section.

Table 3—Empirical Test for Dividends-Investment Causality, Sample Period 1953-1989

F-Statistics: $F_{\alpha=0.05,\ df=2,29} = 3.33$, $F_{\alpha=0.10,\ df=2,29} = 2.49$

Percentiles	Dividends - Gross Investment Differenced Series 204 Firms: Dividends	Investment	Dividends - Net Investment Differenced Series 212 Firms: Dividends	Investment
5	0.097	0.159	0.151	0.144
10	0.231	0.270	0.278	0.288
25	0.628	0.767	0.677	0.788
50	1.838	2.139	1.900	1.894
75	4.718**	4.454**	4.318**	4.127**
90	8.782**	7.854**	8.055**	9.449**
95	12.224**	12.859**	12.330**	18.354**

Dickey-Fuller Statistics: $DF_{\alpha=0.05,\ n=36} = -2.95$, $DF_{\alpha=0.10,\ n=36} = -2.62$

Percentiles	Dividends - Gross Investment Differenced Series 204 Firms: Dividends	Investment	Dividends - Net Investment Differenced Series 212 Firms: Dividends	Investment
5	1.469	-3.134**	1.469	-2.959**
10	0.488	-3.479**	0.398	-3.613**
25	-0.833	-4.319**	-0.885	-4.385**
50	-2.671*	-5.445**	-2.736*	-5.505**
75	-3.578**	-6.899**	-3.610**	-6.787**
90	-4.391**	-8.175**	-4.530**	-8.063**
95	-5.478**	-9.227**	-5.724**	-9.003**

** Significant at the 0.05 level
* Significant at the 0.10 level

dividends to investment.[6] Under the null hypothesis of no causal relationship we expect to observe such F-statistics only at the 95th percentile and above. Similar results appear in the columns labeled "investment." This finding is less interesting, as causality in the direction from investment to dividends does not violate the separation principle.[7]

To determine the overall significance of the results, we can view the tests as sampling from a binomial distribution with $p = 0.05$. We then evaluate the complement of the cumulative binomial probability, $P\{N>k\}$, for the number of significant observations of the F-statistic found. This is the probability, under the null hypothesis, of finding a higher frequency of significant F-statistics than is observed in the sample. Thus, it could be viewed as a measure of the significance level of the aggregate test results, with a lower probability corresponding to greater significance. For both investment proxies, $P\{N>k\}$ is

[6] For the sample involving gross investment, 70 of the 204 firms exhibit F-statistics greater than the critical value at the $\alpha=0.05$ level. The corresponding numbers are 71 of 212 for net investment. This is approximately 33 percent of each sample.

[7] Table 3 reports results using the 2-lag specifications of equations (2) and (3). Our series are long enough to allow 3-lag specifications, which are not feasible with the 20 year series. All tests were repeated using three lags, but the results essentially were unchanged.

less than 0.001. These results support the conclusion that the distribution of F-statistics is significantly different from what one would expect under the null hypothesis.

An alternative and potentially more efficient means of aggregating the statistics derived from the individual block F-tests is a χ^2 goodness-of-fit test. In this test a frequency table of the sample F-statistics, rather than a simple proportion, is used to test the hypothesis that the distribution conforms to the F distribution under the null. Results from this test are shown in Table 4.

Table 4—Chi-Squared Goodness-of-Fit Tests

Critical Value for Chi-Squared ($1 - \alpha = 0.95$, df = 19) = 30.14

	Gross Investment 204 firms		Net Investment 212 firms	
Excluded Variable	k	Test Statistic	k	Test Statistic
Dividends	70	321.996**	71	334.833**
Investment	67	313.933**	66	293.182**

The columns labeled k show the number of firms with F-statistics significant at the 0.05 level

** Significant at the 0.01 level

The χ^2 test results show that the distributions of test statistics are significantly different from what they would be under the null hypothesis. Table 3 and the binomial test described above imply that the deviation is due to test statistics that are generally greater than those from the actual F distribution. Thus, although we are not justified in concluding that most firms exhibit Granger causality, the test results support the inference that a substantially greater than random proportion of the firms tested do exhibit this behavior.

One potential concern is the impact of firms with nonstationarity in the differenced series. To address this issue, the sample is divided based on stationarity. The first group includes firms that passed the test for stationarity at the $\alpha = 0.05$ level for both dividend and investment series. This group consists of 83 firms for tests involving gross investment and 90 firms for tests involving net investment. The second group has the remaining firms, for which either dividends or investment fail to pass the test for stationarity. Causality test F-statistics from the two subgroups are almost indistinguishable.[8] Our findings do not appear to be driven by nonstationarities in the differenced series.

Table 5 lists the 70 firms that showed significant ($\alpha = 0.05$ level) causality in the direction from dividends to investment in tests involving the gross investment series. These firms do not appear to exhibit any immediately identifiable common characteristics, apart from the fact that they are predominantly large manufacturing firms. This may be due, at least in part, to selection bias. No significant clustering within industry groups is apparent. One interesting observation is the evident success of the firms listed; most are household names. Similar observations can be made about firms from the net investment tests.

[8] A table is available from the authors upon request.

Table 5—Listing of Firms Exhibiting Dividend → Gross Investment Causality (70 of 204 firms exceed critical value of $F_{\alpha=0.05,df=2,29} = 3.33$), Sample Period 1953-1989

Company Name	Industry Group	F-statistic
Bristol Myers Squibb	Pharmaceutical	67.016
Avon Products	Perfume, Cosmetic, Toilet	39.062
Delta Air Lines Inc	Air Transport, Scheduled	35.400
Culbro Corp	Tobacco Products	20.131
Georgia-Pacific Corp	Millwork, Veneer, Plywood	17.804
Standard Products Co	Motor Vehicle Part	15.304
Cleveland-Cliffs Inc	Metal Mining	14.506
Minnesota Mining & Mfg	Convrt Paper, Paperboard,	13.625
Procter & Gamble Co	Soap, Detergent, Toilet Preps	13.609
Lilly (Eli) & Co	Pharmaceutical	13.598
K Mart Corp	Variety Stores	13.276
CBS Inc	Television Broadcast	12.224
Phillips Petroleum Co	Petroleum Refining	11.619
Stone Container Corp	Paperboard Mills	10.841
Unilever NV -NY Shares	Food And Kindred Products	10.495
Federal Paper Board Co	Paperboard Mills	10.480
Imcera Group Inc	Pharmaceutical	10.445
Polaroid Corp	Photographic Equip & Supply	10.254
Baxter International	Pharmaceutical	9.461
Texaco Inc	Petroleum Refining	9.371
Kellogg Co	Grain Mill Products	9.089
Eagle-Picher Industries	Motor Vehicle Part	8.782
May Department Stores	Department Stores	8.762
USG Corp	Concrete, Gypsum	8.173
Ametek Inc	Industrial Measurement	8.060
Homestake Mining	Gold And Silver Ores	7.805
Westvaco Corp	Paper Mills	7.546
Asarco Inc	Prim Smelt, Refining Nonferrous	7.464
Anheuser-Busch Cos Inc	Malt Beverages	7.254
Goodyear Tire & Rubber	Tires And Inner Tubes	7.219
Woolworth Corp	Variety Stores	7.041
Heinz (H.J.) Co	Can, Frozen Preservation Fruit, Vegetables	6.929
Bausch & Lomb Inc	Ophthalmic Goods	6.842
Boeing Co	Aircraft	6.781
Royal Dutch Pet -NY Reg	Petroleum Refining	6.561
Alcan Aluminum Ltd	Prim Production Of Alum	6.529
Sun Co Inc	Petroleum Refining	6.368
Eastman Kodak Co	Photographic Equip & Supply	6.266
Borden Inc	Food And Kindred Products	6.084
Johnson Controls Inc	Automatic Regulating Cont	5.947
Champion International	Paper Mills	5.900
Masco Corp	Wood Household Furniture	5.878
Black & Decker Corp	Metalworking Machinery	5.665
Merck & Co	Pharmaceutical	5.584
Grace (W.R.) & Co	Chemicals & Allied Prods	5.501
Pfizer Inc	Pharmaceutical	5.280
Air Products & Chemicals	Industrial Inorganic Chemicals	5.172
Pratt & Lambert Inc	Paints, Varnishes, Lacquers	5.126
Brown-Forman -cl B	Beverages	5.094
Walgreen Co	Drug & Proprietary Stores	4.898
Kroger Co	Grocery Stores	4.749
Honeywell Inc	Automatic Regulating Cont	4.718
Dresser Industries Inc	Construction, Mining	4.625
Northrop Corp	Aircraft	4.574
Rubbermaid Inc	Plastics Products, Nec	4.491
Halliburton Co	Heavy Construction-Not Building	4.439
SPS Technologies Inc	Bolt, Nut, Screw, Rivets	4.410
West Point-Pepperell	Brdwoven Fabric	4.397
Amoco Corp	Petroleum Refining	4.344
Maytag Corp	Household Appliances	4.226

Table 5—Listing of Firms Exhibiting Dividend → Gross Investment Causality (continued)

Company Name	Industry Group	F-statistic
Kimberly-Clark Corp	Paper Mills	4.014
National Intergroup Inc	Drugs And Proprietary-Wholesale	3.990
General Electric Co	Electrical, Other Electrical Eq, Ex Computer	3.874
Unocal Corp	Petroleum Refining	3.826
Penney (J.C.) Co	Department Stores	3.718
McDonnell Douglas	Aircraft	3.672
Tootsie Roll Industries	Sugar & Confectionery	3.539
American Greetings	Greeting Cards	3.404
Amax Inc	Prim Production Of Alum	3.379
Eaton Corp	Motor Vehicle Part	3.372

Requiring that firms in the sample release financial statements for all years from 1952 to 1989 induces some survivorship bias. Including data from delisted firms on the Compustat research tape is not a viable alternative, however, because we have demonstrated that causal relations may be undetectable in shorter time series. The series length used in this section, T = 37, may be near the minimum necessary for reliable inference.

We have not attempted to explain why firms in our sample violate the separation principle. There are several possible explanations for this phenomenon that could provide fruitful directions for future work. One approach would be to look for agency factors or other market imperfections that may rationalize these findings. Another possibility is to consider external financing separately, as suggested in the theoretical work of Miller and Rock (1985). This task would pose some interesting challenges as accounting flow of funds disclosures have not been consistent during the sample period.

CONCLUSIONS

While Granger causality techniques can demonstrate the existence of causal relationships between time series, it is more difficult to prove conclusively that such relationships do not exist. We use simulations to explore the limitations of Granger causality methodology. Our tests could not detect any relationship between simulated dividend and investment series of length 20, even though the series were constructed with investment determined residually. The discriminatory power of the test is too weak for series of 20 observations.

These techniques can be effective if longer series are used. In our analysis, Granger causality methodology is employed with a significantly longer sample than in earlier studies. We find statistically significant evidence of Granger causality in the direction from dividends to investment in approximately 33 percent of the firms. These companies do not appear to be clustered in any particular industry group.

Our results are consistent with the survey results of Partington. Because our study employs a much larger sample of firms and a more objective methodology, it increases the credibility of Partington's conclusions.

We find a larger proportion of firms demonstrating dividend-investment causality than did Pruitt and Gitman. This may be due in part to differences in methodologies. We examine the historical record of dividend payments and investment expenditures; they use survey techniques to address whether managers currently perceive linkages to exist between dividends and investment. While managers' perceptions may not correspond precisely with reality, they do provide some indication of the policies that management is attempting to implement now and in the future. Conversely, time series methods provide evidence of past policy actions.

Our findings suggest that the possibility of bias in management perceptions may be strong enough to warrant caution in the interpretation of survey results. Furthermore, it appears that market imperfections exist that are substantive enough to cause some managers to assign dividends priority over investment in funds allocations.

REFERENCES

1. Dhrymes, P., and M. Kurz, "Investment, Dividends and External Finance Behavior of Firms," in R. Ferber (ed.), *Determinants of Investment Behavior* (New York: Columbia University Press, 1967), pp. 427-467.

2. Dickey, D.A., and W.A. Fuller, "Distribution of the Estimators for Autoregressive Time Series with a Unit Root," *Journal of the American Statistical Association*, 74 (1979), pp. 427-431.

3. Fama, E.F., "The Empirical Relationships Between the Dividend and Investment Decisions of Firms," *American Economic Review*, 64 (1974), pp. 304-318.

4. Fama, E.F., and H. Babiak, "Dividend Policy: An Empirical Analysis," *Journal of the American Statistical Association*, 63 (1968), pp. 1132-1161.

5. Fama, E.F., and M. Miller, *The Theory of Finance* (New York: Holt, Rinehart and Winston, 1972).

6. Fuller, W., *Introduction to Statistical Time Series*, (New York: John Wiley and Sons, 1976).

7. Granger, C., "Investigating Causal Relations by Econometric Models and Cross Spectral Methods," *Econometrica*, 37 (1969), pp. 424-438.

8. Granger, C., "Testing for Causality: A Personal Viewpoint," *Journal of Economic Dynamics and Control*, 2 (1980), pp. 329-352.

9. Lintner, J., "Distribution of Incomes of Corporations Among Dividends, Retained Earnings and Taxes," *American Economic Review*, 46 (May 1956), pp. 97-113.

10. Miller, M., and F. Modigliani, "Dividend Policy, Growth, and the Valuation of Shares," *Journal of Business*, 34 (1961), pp. 411-433.

11. Miller, M., and K. Rock, "Dividend Policy Under Asymmetric Information," *Journal of Finance*, 40 (1985), pp. 1031-1051.

12. Partington, G.H., "Dividend Policy and its Relationship to Investment and Financing Policies: Empirical Evidence," *Journal of Business Finance and Accounting*, 12 (1985), pp. 531-542.

13. Pruitt, S.W. and L.J. Gitman, "The Interactions between the Investment, Financing, and Dividend Decisions of Major U.S. Firms," *The Financial Review*, 26 (1991), pp. 409-430.

14. Schmidt, P., "Dickey-Fuller Tests with Drift," *Advances in Econometrics*, 8 (1990), pp. 161-200.

15. Smirlock, M., and W. Marshall, "An Examination of the Empirical Relationship Between the Dividend and Investment Decisions: A Note," *Journal of Finance*, 38 (1983), pp. 1659-1667.