"The Components Of Stock Prices: Evidence From The Japanese Stock Markets"

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Abstract

This study establishes permanent and temporary components of equity returns in the Japanese equity markets using, as explanatory variables, the fundamentals of stock prices. We employ the structural Vector Autoregression Approach (VAR) to a data set for the period January 1955 to December 1997. We consider the "information" hypothesis of dividends to justify the components of stock returns.

I. Introduction

Temporary and permanent components of stock returns have been documented by numerous studies (see Lee Bong-Soo (1995,1996a&b, 1997, 1998), Cochrane (1994), Eckbo and Liu (1993), Campbell and Ammer (1993), McQueen (1992), Poterba and Summers (1988), Fama and French (1987,1988), Lo and McKinley (1988)). What has yet to be established is whether this is evidence of market efficiency or inefficiency.

Another line of research, supports the proposition hypothesis of dividends, in that only unexpected changes in dividends, may change stock prices (see Ross (1973), Charest

(1978), Miller and Rock (1985), Bradley (1989), Chang and Cheng (1991), Denis Denis and Sarin (1994)). These studies conclude that prices adjust efficiently to information related to dividends.

The purpose of this study is to explore temporary and permanent components of stock prices in Japan, employing the structural Vector Autoregressive (VAR) approach, using as predictive variables the dividend-price ratio, dividend growth rate, and the term structure of interest rates and attempts to explain fluctuations in stock prices using the "information hypothesis" of dividends. The choice of predictor variables is motivated by the existing evidence for the U.S. which in turn, is influenced by the practice of fundamental security analysts.

Readers with comments or questions are encouraged to contact the author via e-mail.

II. Methodology, Data Analysis, Variables In The System, Definitions

The method used here the structural Vector Autoregression (VAR) approach, is a modification of the "atheoretical" VAR approach developed by Sims (1980). The main advantage of the VAR analysis is that it is suited to study the dynamic responses of a system to a shock. Analysis of the pattern of innovations and responses in stock markets can be precisely performed by the impulse response function analysis in the VAR model.

For the analysis we construct a basic two-variable model where the variables are stock returns, dividend growth rate or stock returns and dividend-price ratio; extended three and four-variable models where the variables are stock returns dividend growth rates, dividend-price ratios and/or interest rates. The variable of interest is real stock prices. This variable is assumed to be driven by shocks in (u^d). Shocks in dividends come mainly from changes in the dividend policy (for instance, increases or decreases of the dividend payout ratio) of a firm. The assumption that will be used to achieve identification of this type of disturbance is that unexpected news about dividends only have temporary effects on real stock returns. An increase in the dividend payout-ratio for example, may initially cause real returns to deviate from their long-run permanent value or mean, because investors perceive this as a signal of "favorable news" about the future performance of the firm and so stock prices increase (see Miller and Rock 1985), Kwan (1981), Denis, Denis and Sarin (1994)). In the long-run however, stock prices will return to their long-run (permanent) value. Put it differently, we assume that in the long-run surprises in dividends have no persistent effects on stock returns. This assumption agrees with the efficient market hypothesis in that only unanticipated changes in dividends matter.

Assume that the structural model is:

$$X_t = \sum_{i=1}^n A_i X_{t-i} + u_t \quad (1)$$

where $X=(RS,D/P)'$: the vector of variables used in the model, RS = real stock returns, D/P =the dividend price ratio, $u=(u^{RS}, u^{D/P})'$ are serially and cross-equation uncorrelated.

From (1) we get the reduced form: $X_t = \sum_{i=1}^n G_i X_{t-i} + e_t \quad (2).$

An illustration of a two variable model is:

$$RS_t = d_{11} RS_{t-1} + d_{12} D/P_{t-1} + e_{1t} \quad (2.a)$$

$$D/P_t = d_{21} RS_{t-1} + d_{22} D/P_{t-1} + e_{2t} \quad (2.b)$$

Inverting (2) we get:

$$X_t = \sum_{s=0}^{\infty} G_s X_{t-s} \quad (3)$$

where $X=(RS,D/P)'$, and $u=(u, u^{D/P})$ are the structural real stock returns and dividend-price ratio shocks respectively that are serially uncorrelated and cross-uncorrelated.

In matrix form the model is :

$$(1-L) = \begin{bmatrix} G_{11} & G_{12} \\ G_{21} & G_{22} \end{bmatrix} = \begin{bmatrix} u^{RS}_t \\ u^{D/P}_t \end{bmatrix} \quad (3.1)$$

For example the returns equation is

$$RS_t = [G_{11}/(1-L)] u^{RS}_t + [G_{12}/(1-L)] u^{D/P}_t \quad (3.1.1)$$

where $V_{ij} = G_{ij}/(1-L)$ is the impulse response function of each input j . If we forecast RS_t by (3.1), and we write the derivation in RS_t from the forecast generated at time $(t-k-1)$ as:

$$RS_t - RS_{t-k-1} = S^{k_i=0} g_{11,i} u^{RS}_{t-i} + S^{k_i=0} g_{12,i} u^{D/P}_{t-i} \quad (3.2)$$

then the proportion of the variance of stock returns forecast errors at horizon k which can be explained by the shocks in dividend growth rates or dividend-price ratios will be:

$$V_i(k) = S_{i=0}^k g_{11,i}^2 / S_{i=0}^k g_{11,i}^2 + S_{i=0}^k g_{12,i}^2 \quad (3.3)$$

The impulse response functions and the variance decompositions are estimated based on equations (3.2) and (3.3).

The data base consists of time series of the NIKKEI-225 real stock price index for the end of the month quotes, and the corresponding dividend series, from January 1955 to December 1997. The NIKKEI-225 index is a price-weighted index of only 225 stocks out of 1500 stocks listed in the Tokyo Stock Exchange, representing about 50% of total capitalization. The data were provided by the Nihon Keizai Shimbun. Since there is no equivalent to Treasury bills in Japan for short term rate I use a combined series. The series is consisted of the call money rate from January 1955 to January 1977 and the 30-day Gensaki (repo) from February 1977 to December 1997.² For the long-term Japanese government yield, I use a value-weighted index of yields on bonds with 9 to 10 years maturity.³ The data are deflated by the Japanese consumer price index. Interest rates and the CPI are taken from the historical statistics of the OECD.

The monthly stock market prices were transformed to monthly rates of return. Real returns are nominal returns adjusted for the inflation rate defined as:

$$RS_t = ((S_t - S_{t-1} + D_t) / (S_{t-1})) - INF_t \quad (4)$$

where RS_t is stock returns at time t , S_t is the stock price at time t , S_{t-1} is the lagged stock price at time $t-1$ and D_t is the dividend series at time t . The dividend-price ratio is defined as: $d_t = D_{t-1} / S_t$ where D_{t-1} is the dividend of last period, to ensure that it is known at the start of month t , and S_t is the price of the stock at time t ; Dividend growth rate is the growth rate of actual dividends given by: $DG_t = D_t - D_{t-1} / D_{t-1}$, where D_t is the dividend at time t , and

D_{t-1} , is the dividend at time $t-1$. For the nominal short-term interest rate we take the first difference: $DST_t = ST_t - ST_{t-1}$, where ST_t is the short term interest rate of country i at time t , and ST_{t-1} is the short term rate at time $t-1$.

III. Empirical Results

III. 1 Impulse Response Functions (IRFs)

The results of this paper extend the research of Campbell (1991), Campbell and Ammer (1993), Kothari and Shanken (1992), Cochrane (1994), Fama and French (1998b), Lee (1995, 1998) to the Japanese stock market and establish temporary and permanent components similar to those of the American stock market. The initial step in the empirical implementation requires estimation of (4). It is crucial for the estimation that the series be involved are stationary. Tables 1 and 2 show unit root and cointegration tests of the original and the transformed series that seem to support the hypothesis that the series of interest are stationary.

In Table 3, Figure 1 shows the responses of real stock returns due to a shock in the dividend growth rate, while figure 2 shows the responses due to a shock in the dividend-price ratio. Each figure is a plot of the impulse response function (IRF) of real stock returns (RS) due to a shock in either dividend growth rate (DG) or the dividend-price ratio (D/P). The vertical axis in each figure denotes the level of returns while, the horizontal axis denotes time in months. The line in the plot represents the impulse response due to a shock in DG or D/P. Table 5 in the appendix reports the same impulse responses in the form of numbers rather than figures.

Based on the dividend information hypothesis and efficient capital markets, we would expect that a typical shock (unexpected news) in dividends will affect stock prices only temporarily. We now explain the implications

TABLE 1
STATIONARITY TESTS

A. Original Variables						
VAR.	K	DF(t)	PP(t)	K	ADF(t)	APP(t)
JPS	0	-0.500	-0.501	1	-0.812	-0.629
JPD	0	-1.194	-1.197	1	-0.653	-0.814
CP	0	1.641	1.645	1	1.329	1.513
JPIR	0	-1.293	-1.296	1	-1.587	-1.434
D/P	0	-1.900	-1.904	1	-2.140	-1.876
B. Transformed Variables						
VAR.	K	DF(t)	PP(t)	K	ADF(t)	APP(t)
RS	0	-14.6 ⁺⁺	-14.7 ⁺⁺	1	-10.9 ⁺⁺	-14.6 ⁺⁺
DG	0	-32.4 ⁺⁺	-32.5 ⁺⁺	1	-24.2 ⁺⁺	-33.4 ⁺⁺
D/P1	0	-23.7 ⁺⁺	-23.7 ⁺⁺	1	-17.1 ⁺⁺	-23.7 ⁺⁺
INF	0	-18.6 ⁺⁺	-18.6 ⁺⁺	1	-14.7 ⁺⁺	-18.7 ⁺⁺
IR	0	-18.6 ⁺⁺	-18.7 ⁺⁺	1	-13.1 ⁺⁺	-18.8 ⁺⁺

Notes: 1) The model is $(1-L)x_t = a + bx_{t-1} + \sum_{i=1}^q (1-L)x_{t-i} + u_t$. DF(t) is the Dickey-Fuller t-ratio for b with q=0 (no lags in the equation). PP(t) is the Phillips - Perron (1988) Z(t) statistic for b. ADF(t) and APP(t) the augmented versions of the statistics are calculated with one lag. ⁺⁺ significant at the 1% level. Critical value=-3.46. If the t-ratio is not significant the null that x_t is not a unit root process cannot be rejected. 2). RJP = real stock returns, DG = real dividend-growth rate, DP1 = differenced dividend- price ratio, INF = inflation rate, IR = percentage change in interest rates.

TABLE 2
COINTEGRATION TESTS

JAPAN:NIKKEI-225				
Variables	K	DF(t)	K	ADF(t)
RJP and D/P	0	-15.4	1	-10.5
RJP and DG	0	-14.2	1	-10.8
RJP and ST	0	-14.8	1	-11.0
DG and D/P	0	-31.0	1	-24.0
DG and ST	0	-31.8	1	-24.4
D/P and ST	0	-35.9	1	-21.3
RJP,DG and D/P	0	-15.1	1	-10.3
RJP,DG,D/P and ST	0	-15.2	1	-10.3

Notes: The model is $(1-L)z_t = rz_{t-1} + \sum_{i=1}^p (1-L)z_{t-i}$. The null hypothesis in t-tests is $r = 0$. If the null hypothesis cannot be rejected then variables being tested are not cointegrated. Critical values are from Hamilton (1994) and Engle and Yoo (1987).

TABLE 3
Impulse Response Functions

Figure 1

Figure 4

Figure 2

Figure 5

Figure 3

Figure 6

of the impulse response functions.

Figure 1 indicates that DG influences stock returns negatively. The impulse response function is fluctuate between 0.0% to -2.2% and it does not end up close to where it started. The rate of return (the impulse response line in the graph) decreases in approximately one month and slowly, after about 48 months, it reverts to zero. Thus, the fluctuation in returns is completely transitory. This result contrasts the theories that dividends are random walks (Marsh and Merton (1986,1988)). As detailed below this transitory effect supports and interprets the theories of predictable components in stock returns.

Figures 2 show the dynamic response of real stock returns (RS) to typical shock in the dividend-price ratio (D/P). As can be seen in the innovations in dividends are transmitted into stock prices within approximately one month reach their highest level, (7.0%), at about two to three months and then taper off, returning back to zero in twenty four months. Fama and French (1988b) have shown the same components in stock returns but with a different approach for the U.S. market (see Campbell (1991) for more on this). This observation is consistent with the view that the stock market signals (or leads) changes in dividend policy and that the relation between stock returns and dividend-price ratios is positive (see Miller and Rock (1985)). Eckbo and Liu (1993) employing a univariate approach emphasize an alternative view for annual U.S. stock market data over the period 1926 to 1987. Also see McQueen (1992) for a different finding on the long-horizon mean-reverting stock prices.

Figures 3 to 6 show impulse response functions of extended three and four-variable models, which test the robustness of the basic model. Comparing Figure 2 with Figure 3 and/or 4 in order to test the robustness of the

predictive ability of the D/P ratio, we observe that the inclusion of the DG rate and/or the short term interest rate (IR) along with the D/P ratio in the VAR model did not alter the pattern of the IRF of the basic model (RS,D/P)'. Stock returns show persistent temporary components and mean reverting behavior. Notice, the increase in the return horizon in Figure 3 when IR is included in the VAR model. This is probably due to the forecasting ability of IR over stock returns. Comparing figures 1 with 5 and/or 6 a shock in the DG rate, holding D/P constant, does not alter the reaction of stock returns in Japan. The pattern of the IRFs of the three and four-variable VAR model is similar to the two-variable model, implying the robustness of the basic model.

How important are the transitory components of stock returns? The above figures gave us some indication. All figures plot the responses to one standard-deviation shocks. Thus, the relative size of the IRFs give some measure of the relative importance of the shocks. However, to make inferences about the importance of the transitory components of stock returns we must examine the variance decompositions of the VAR systems along with the IRFs.

III. 2 Variance Decompositions

The impulse response functions enabled us to analyze the dynamic behavior of stock returns due to unanticipated shocks given in the D/P ratio and dividend growth rate. On the other hand, the variance decompositions show the relative importance of the shocks in explaining the variability of the dependent variable (RS_t) in the model. The approach used here is different from two other approaches that have been popular in the literature: a) the "contemporaneous regressions" approach which regresses stock returns on the innovations that may affect the stock market and breaks returns into a component which is a reaction to measured news variables and a residual, called

'noise' (see Poterba and Summers (1988) and Cuttler (1994)). This approach cannot tell if the change in returns occurs because of changes in expectations about dividends or returns. b) The univariate approach which examines the autocorrelation function of stock returns with the objective to decompose stock prices into temporary and permanent (see Fama and French (1988), Ecko and Lui (1993), McQueen (1992), McQueen and Thorley (1994)). The approach we use here, decomposes the variance of unexpected real stock returns into the var-

iance of news about dividend yields, or the variance of news about dividend growth rates and the variance of news about real stock returns (see Campbell 1991). In contrast to Campbell's model we include the dividend growth rate into our the model³. Table 5 reports the variance decompositions for the two variable model. The time horizons are chosen to be one to twelve, twenty four, thirty six, forty eight, and sixty months to reflect short and long holding periods of stock returns.

Table 4

A. VARIANCE DECOMPOSITIONS TWO-VARIABLE MODELS

Month	MODEL (RJP, DG)'		MODEL (RJP, D/P)'	
	RJP	DG	RJP	RJP
1	100.00	0.00	100.00	0.00
6	75.94	24.06	91.53	8.47
12	74.33	25.67	90.12	9.88
24	73.47	26.53	90.06	9.94
36	73.37	26.63	90.06	9.94
48	73.37	26.63	90.06	9.94
60	73.36	23.64	90.06	9.94

B. VARIANCE DECOMPOSITIONS THREE AND FOUR-VARIABLE MODELS

Month	MODEL(RJP,DG,D/P)'			MODEL(RJP,DG,D/P,IR)			
	RJP	DG	D/P	RJP	DG	D/P	IR
1	100.00	0.00	0.00	100.00	0.00	0.00	0.00
6	74.16	21.77	4.05	74.04	21.66	3.86	0.42
12	71.63	21.22	7.13	71.47	21.11	6.93	0.47
24	71.27	21.00	7.71	71.12	20.90	7.50	0.47
36	71.24	20.98	7.76	71.09	20.87	7.54	0.47
48	71.24	20.98	7.77	71.09	20.87	7.54	0.47
60	71.24	20.98	7.77	71.09	20.87	7.54	0.47

TABLE 5.
Impulse response functions: two-variable models

Model (RJP, DG)'		Model (RS,D/P)'	
0.000000000000	0.0000000	-0.000404352203	1.7991009E-006
-0.020201122110	0.0067714	-0.000409941394	1.3615626E-006
-0.001079881374	0.0059621	-0.000331286822	1.0304329E-006
-0.002248912815	0.0056723	-0.000280996838	7.7983322E-007
-0.006396900104	0.0027335	-0.000305047075	5.9017918E-007
-0.004445682188	0.0024300	-0.000268159980	4.4664859E-007
0.000756448357	0.0020534	-0.000220770739	3.3802441E-007
-0.003601687479	0.0014116	-0.000212051845	2.5581744E-007
-0.003756127989	0.0010857	-0.000210653266	1.9360307E-007
-0.001619459573	0.0008297	-0.000171703008	1.4651913E-007
-0.002642200725	0.0006260	-0.000153861073	1.1088592E-007
-0.004148345344	0.0004741	-0.000152863429	8.3918654E-008
-0.001911696576	0.0003578	-0.000137779005	6.3509779E-008
-0.001242929153	0.0002714	-0.000115183178	6.3509779E-008
-0.002054200848	0.0002054	-0.000111670701	4.8064308E-008
-0.002008877444	0.0001553	-0.000105380562	3.6375149E-008
-0.000989168463	0.0001176	-0.000090515556	2.7528774E-008
-0.001371962229	0.0000890	-0.000080686221	2.0833822E-008
-0.001608827829	0.0000673	-0.000078595657	1.5767072E-008
-0.001335627469	0.0000510	-0.000069898237	1.1932547E-008
-0.000851736645	0.0000386	-0.000060880962	9.0305714E-009
-0.001184992693	0.0000292	-0.000057277946	6.8343516E-009
-0.001024890346	0.0000221	-0.000053675987	5.1722488E-009
-0.000710990023	0.0000167	-0.000046543616	3.9143666E-009
-0.000703013362	0.0000127	-0.000042359937	2.9623992E-009
-0.000834624248	9.5755358E-006	-0.000039966926	2.2419487E-009
-0.000609874776	7.2467780E-006	-0.000035918689	1.6967106E-009
-0.000527594685	5.4843756E-006	-0.000031607374	9.7178893E-010
-0.000592979595	4.1505842E-006	-0.000029582654	7.3545150E-010
-0.000552525224	3.1411695E-006		
-0.000390458507	2.3772422E-006		

Despite the strong forecasting power for dividend-price ratio, we found in the IRF's analysis, the variance decomposition attributes only 8-10% (see also Fama and French (1988)) from the short to the long run of the variance of stock returns to the news about future dividends, and 90-92% to the variance of news about future returns at a horizon of sixty months. This implies that most of the variation in returns comes from prices and not dividends therefore, prices and not dividends adjust for the mean reversion in returns (Cochrane 1994).

The results of the dividend growth rate on the other hand, are consistent with the empirical findings of the IRFs in Figures 2. The decompositions of variance shows that the shocks in DG do not explain more than 26.65% of the error variance of real stock returns, at a horizon of 60 months. Comparing the results of variance decompositions of DG and D/P ratio we notice that the DG is superior in explaining stock. Kothari and Shanken (1992), report that the DG rate is superior to D/P in explaining real stock returns, in the U.S. markets.^{4,5}

Table 6 presents variance decompositions of the three and four-variable VAR models. Overall the results of the extended models enhance the results of the basic (two-variable) model.

III. 3 Discussions-Implications

The results of the IRFs provide evidence of strong transitory variation in returns of markets. They provide also evidence for mean reversion. Transitory variation and mean reversion require long horizon predictability in returns, (see Cochrane (1994)). Fama and French (1988a,b), Poterba and Summers (1988) have shown that predictability comes from long-horizon regressions. See also Lo (1991) and Reinchnstein and Rich (1994).⁵

Our results show that in the Japanese markets, stock returns exhibit the same pattern of behavior due to the innovations in dividend yields as they are reported for the U.S.. The fact that the Japanese market is characterized by the same permanent and temporary components as the U.S. that the two markets are integrated.

There is no however, consensus regarding the implications of the components of stock prices for market efficiency. Considering the "dividend information hypothesis" to explain the strong relationship between real stock returns and dividend yields these results are not surprising. As was mentioned, in the literature, cash dividend announcements are used as a signaling device by managers to convey information to investors and in general to market participants about changes in their expectations of the future prospects of the firm. We expect then stock prices to change temporarily in response to dividend changes because, the markets may believe that the change indicates something about the probable future course of earnings. If it becomes clear that the change was not made because of any change in estimated future earnings, this temporary effect should disappear. This "expectations effect" is consistent with the signaling hypothesis (see Miller and Rock (1985), Kwan (1985)), which states that only unexpected changes in dividends provide the market with clues about unexpected changes in profits, which in turn trigger off the price movements. The change in stock returns therefore, is consistent with the efficient market hypothesis, as has been noted by many researchers in empirical finance (see Petitt (1973), Aharony and Swary (1980), Bradley (1988), Hess (1981)), that on average the stock market adjusts in an efficient manner to new dividend information. Although, abnormal returns may be earned by some investors, they would only be related to the management's expectations of the firm's future. In other words, abnormal returns will

not persist.

The evidence of the dividend growth rate is probably attributable to: 1) the key accounting differences for investment and taxes in Japan. One accounting difference "the equity method" has the effect of increasing the firm's payout ratio for a given level of dividends while at the same time it reduces the firm's tax obligation. Firms therefore, emphasize on higher dividend payout ratios. 2) lower risk associated with a given level of growth in Japan compared to the other countries. Thus, lower volatility of earnings may enable firms to a higher payout ratio. 3) higher growth expectations in Japan may be another reason for high payout ratios, which makes our result surprising because it is believed that Japanese firms are long-term oriented. Thus, we expected the dividend growth rate to have no influence on real stock returns (see Michel and Shaked (1986) for more on the Japanese dividend policy). 4) The "distortion" in the earnings Japanese firms induced by accelerated depreciation allowances.

Finally, the results of the variance decomposition seem surprising. The VAR system forecasts only a small share of the monthly variance of real stock returns; yet at the same time it attributes most stock market variation to changing expected stock returns (see Campbell and Ammer (1993)).

IV. Suggestions For Future Returns

Our study has shown that stock prices in Japan are characterized by temporary and permanent components which are similar to the U.S. stock prices caused by the fundamentals of stock prices. We justify these components by using the information hypothesis of dividends.

One avenue for future research involves expanding the set of information variables used in the model. Macroeconomic vari-

ables, such as industrial production, money supply, unemployment rate, inflation rate may also influence stock prices.

Another area of future research, which I am currently exploring, involves different trading strategies which investigate the existence of possible profit opportunities, based on the predictability of stock returns in Japan.

Other econometric methods, such as ARCH-type models can be used to investigate common volatility sources in Japan and the U. S. stock markets.

Footnotes

1. The Gensaki rate, an interest rate applied to bond repurchase agreements, is less subject to regulations than the call money rate, but it became available only after 1977. The call money rate is the unconditional rate, which is applied to transactions maturing in less than a month. I use the Gensaki rate with one month maturity.

2. The same impulse responses in the form of numbers rather than figures are available upon request.

3. The reason Campbell (1991) does not include the dividend growth rate in his model is his concern about seasonalities in dividends. I run the model with and without seasonally adjusted data. The results are very similar.

4. Because of concerns that our empirical findings may be sensitive to the ordering of the variables in the VAR system, I tested the robustness of these results by reestimating the models in different orderings. The change in ordering does not affect the results significantly. Results are available upon request.

5. Kothari and Shanken (1992) show that the

dividend growth rate explains 50 to 70% of the variance in stock returns. Campbell and Ammer (1993) show that the dividend growth rate never explains no more than 15% of stock returns. Campbell and Shiller (1988) report no explanatory ability of the DG rate.

6. The implications of significant transitory components are important for long-term investors since stock returns are less risky in the longer run (Poterba and Summers 1988).

7. These models explain mean reversion primarily by using theories of fads, noise trading, rational speculative bubbles, and time-varying expected returns.

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Notes