Stock Price Relationships between Japanese and U.S. Stock Markets from the 1980s*

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Abstract

This paper presents an empirical analysis of the relationship between recent Japanese stock prices and some macroeconomic variables. The theoretical framework of the analysis is followed by application of the empirical method and analysis of the deterministic elements of stock prices. VAR method is applied. The results show that interest rates, especially the domestic interest rate, have not impacted Japanese stock prices. Exchange rates have not been a significant determinant of Japanese stock prices either. U.S. stock prices have significantly influenced Japanese stock prices.

1. INTRODUCTION

During the 1990s, Japan experienced unprecedented recession and deflation for more than 10 years. In that period, Japan conducted an aggressive fiscal policy under severe budget constraints, and the Bank of Japan (BOJ) enforced unprecedented monetary easing. However, because these policies were not enough to end deflation, since 2001, the BOJ has implemented quantitative easing. There is much dispute over whether quantitative easing has been effective and whether it achieved the current economic recovery (Kurihara, 2006).

One of the purposes of BOJ's policy is to influence stock prices. BOJ

has not admitted to this purpose; however, the governor of the Bank of Japan has reiterated that it is important to increase the transfer of funds from safe to risky assets. The quantitative monetary easing policy is strongly related to this purpose. BOJ's monetary policy, especially quantitative easing, has not yet been fully determined. Moreover, the effect of the policy on stock prices has not been discussed at all.

This paper analyzes the deterministic factors of stock prices in Japan, particularly with regard to macroeconomic variables. In general, the most important factor in determining stock prices has been interest rates all over the world. However, in Japan, market interest rates have been almost zero starting with implementation of the zero interest rate policy in 1999 and with quantitative monetary easing policy beginning in 2001. The effect of changes in interest rates on stock prices may have been decreasing or negligible. There may be other macroeconomic factors that affect stock prices.

The following section reviews the relationship between the stock market and other markets. It then provides the theoretical framework of the analysis followed by application of the empirical method and analysis of the deterministic elements of stock prices in Japan. Finally, this paper ends with a brief summary.

2. Relationship between stock market and other macroeconomic factors

The relationship between stock prices and macroeconomic variables has been discussed all over the world. Campbell (1991), Campbell and Shiller (1998), Fama and Schwert (1997), Hodrick (1992), and Keim and Stambaugh (1986) showed that short- and long-term interest rates have a modest degree of forecasting power for excess stock returns. Similarly, other studies, such as Campbell and Shiller (1991) and Fama (1984), have

shown that the slope of the term structure of interest rates helps to forecast excess stock returns.

On the other hand, Campbell and Ammer (1993) showed that short-term interest rates affect stock prices. During the 1980s and 1990s, many researchers analyzed the relationship between stock prices and interest rates.

This paper discusses the determinants of quarterly stock prices in Japan. Stock prices are determined by many factors, including enterprise performance, dividends, other countries' stock prices, gross domestic product (GDP), exchange rates, interest rates, current account, money supply, employment among others. Countless factors impact stock prices.

The factors that influence stock prices change over time. For example, in 1970s and early 1980s, inflation rates were high, which affected stock prices. Since then, in general, interest rates have had much influence on stock prices. This paper focuses on the recent period. Note that interest rates have been quite low, as indicated by the term *zero interest rate*. It is uncertain whether the interest rate has had an effect on stock prices. There is some possibility that other factors have been more influential than the interest rate.

The influence of macroeconomic variables and relationships among them has been changing constantly, as this paper mentioned above. Under such circumstances, theoretical analysis is important. However, the research must rely on empirical analysis.

There is some dispute about statistical properties. For the last 10 years or so, empirical and statistical methods have improved rapidly. Above all, time series analysis has greatly improved. The unit root test, for example, has become popular and necessary to estimation. This paper therefore differs in regard to the empirical methods of some past studies that have addressed this topic.

In academic fields, most studies have used 'rates' of stock prices, which

are more suitable for measuring the effects of some kinds of shocks and events. However, in the real world, price differences are more important to trade in many cases. We use data from both the standpoint of 'academic-interest oriented' and 'investor-interest oriented' approach.

The theoretical framework is as follows.

3. Theoretical framework

3.1 *Empirical method for analysis*

This paper starts with the unit root tests of all of the variables considered and uses an Augmented Dickey-Fuller (ADF) statistical test to determine whether the series is stationary. Standard inference procedures do not usually apply to regressions that contain an integrated dependent variable or integrated regressors. Therefore, it is important to determine whether or not a series is stationary before using it in a regression. To do this, we change some variables from nonstationary to stationary time series and calculate a regression.

The next step analyzes impulse responses. A shock to the i-th variable not only directly affects the j-th variable but is also transmitted to all of the other endogenous variables through the dynamic (lag) structure of the VAR. The impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables.

These methods have not been applied recently to analyze either Japanese or foreign stock markets.

3.2 *Relationships among variables*

Economic theory offers relatively firm concepts for macroeconomic variables as related to stock prices.

Stock prices are influenced not only by dividends and future

expectations for the issuing company's performance but also by macroeconomic variables. Traditional study tells us that an interest rate increase (or decrease) usually induces the decline (or increase) of stock prices. However, empirical studies have produced various results as mentioned above. For example, when economic recovery is too strong, the effect of rising interest rates on stock prices is limited. In the case of interest rates in foreign countries, the influence on domestic stock prices is complicated. Usually, rising foreign interest rates induce a decrease in that country's stock prices, and as a result, domestic stock prices decrease. However, there is some possibility that depreciation of domestic currency by high foreign interest rates may increase domestic stock prices. It is difficult to determine whether changes in the exchange rate produce a positive or negative effect. We can say clearly, however, in an export-oriented country such as Japan, that depreciation of the currency increases exports as well as stock prices. In analyzing recent stock price fluctuations, exchange rate movements seem to be an inevitable factor to consider because large volumes of capital move not only for trade but also for capital investment.

As mentioned above, many factors influence the Japanese stock market. Some effects cannot be analyzed without performing an empirical analysis as in the following sections. It is interesting to note that Japanese stock markets seem to have been influenced by U.S. stock markets. In 2001, Japan implemented quantitative monetary policy. By the middle of the 1990s, the movement of stock prices in Japan and the United States were sometimes opposite. In the United States, the information technology (IT) boom contributed strongly to increasing stock prices. On the other hand, the Japanese economy has had many structural problems and has experienced recession. Fiscal policy could not expand because of severe budget constraints. Traditional monetary policy could not be applied because interest rates were quite low. Stock prices in

Japan decreased during the mid-1990s and after the bubble economy of the 1980s. However, movements of stock prices in the two countries have been similar after 2001, the year quantitative easing policy was implemented in Japan.

4. Stock price and macroeconomic variables

4.1 *General view and sample period*

As mentioned above, one purpose of this study is to analyze stock prices in Japan. The bubble economy collapsed in 1992 and recession started. Since 1992, the Japanese government and BOJ have formulated drastic policy to overcome recession. The sample period is from 1983Q2 to 2006Q2. The starting period is selected because DOW in U.S. started.

4.2 *Empirical Analysis*

Unit root tests. First, unit root tests of each macroeconomic variable related to stock prices are conducted. The variables estimated are Japanese stock price (stockJA), U.S. stock price (stockUS), exchange

Table 1. Unit Root Tests of Each Variable

variable	t value	Lagged first difference	t value
stockJA	-1.962	ΔstockJA	-10.492***
stockUS	-0.582	ΔstockUS	-11.633***
EXCJA	-3.270**	ΔEXCJA	-3.838***
callJA	-1.357	ΔcallJA	-5.603***
FFUS	-2.273	ΔFFUS	-5.010***
GDPJA	-4.881***	ΔGDPJA	-2.596*

Notes: *Significant at 10 percent level, ** is at 5 percent level, and *** is at 1 percent level. Significant levels at 10, 5, and 1 percent are -2.584, -2.893, and -3.504.

rate (yen/ U.S. dollar; EXCJA), Japanese call (interest) rate (callJA), FF rate (FFUS), and GDP (GDPJA). The test method is ADF. Table 1 provides the results.

As shown in the table, all of the lagged variables are significant at least at 10% level. All of the variables that take lagged first difference are stationary.

Regression analysis. Using this result, I regress Japanese stock prices by the U.S. stock price, exchange rate, interest rates, and GDP. Table 2 provides the variables of the estimation equations and the estimated results by OLS.

The results of the equation are not so clear, but they illustrate some interesting points. ΔUstock coefficient is significant. U.S. stock prices sig-

Table 2. Deterministic Elements of the Japanese Stock Price: Lagged First Difference

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-296.757	298.077	-0.995	0.322
ΔstockJA(-1)	-0.095	0.104	-0.909	0.365
ΔstockUS	1.314	0.476	2.758	0.007
ΔEXCJA	7.232	29.097	0.248	0.804
ΔcallJA	-506.309	654.461	-0.773	0.441
ΔFFUS	244.659	471.238	0.519	0.605
ΔGDPJA	0.090	0.056	1.600	0.113
R-squared	0.127	Mean dependent var		70.798
Adjusted R2	0.063	S.D. dependent var		2412.259
S.E.	2334.209	Akaike info criterion		18.424
Sum of resid	4.47E+08	Schwartz criterion		18.619
Log likelihood	-812.873	F-statistic		1.997
D.W.	2.013	Prob (F-ststistic)		0.075

nificantly affect Japanese stock prices. The results are confirmative and show that interdependence of Japanese and U.S. stock prices exist.

VAC analysis

The vector autoregression (VAR) is used for forecasting systems of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables. On the other hands, the VEC model has cointegration relations built into the specification so that it restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. The result of the VAC analysis is shown in Table 3.

Table 3. VAR model for Impulse Response Function: Difference

	STOCKJA	GDPJA	EXCJA	CALLJA	STOCKUS	FFUS
STOCKJA(-1)	0.628762	-0.052240	-0.000164	1.07E-05	-0.007963	1.88E-05
	(0.11974)	(0.20186)	(0.00043)	(1.7E-05)	(0.02821)	(2.3E-05)
	[5.25120]	[-0.25879]	[-0.37634]	[0.62140]	[-0.28228]	[0.80787]
STOCKJA(-2)	0.156320	0.294908	-0.000566	3.47E-05	-0.014570	1.35E-05
	(0.11826)	(0.19937)	(0.00043)	(1.7E-05)	(0.02786)	(2.3E-05)
	[1.32183]	[1.47917]	[-1.31904]	[2.04121]	[-0.52296]	[0.58951]
GDPJA(-1)	-0.096890	0.837794	9.74E-06	7.52E-06	-0.010195	-6.25E-07
	(0.06828)	(0.11511)	(0.00025)	(9.8E-06)	(0.01609)	(1.3E-05)
	[-1.41905]	[7.27823]	[0.03929]	[0.76494]	[-0.63381]	[-0.04716]
GDPJA(-2)	0.068738	0.127428	-3.67E-05	-7.79E-06	0.013592	-2.44E-06
	(0.06781)	(0.11432)	(0.00025)	(9.8E-06)	(0.01598)	(1.3E-05)
	[1.01370]	[1.11468]	[-0.14905]	[-0.79820]	[0.85081]	[-0.18496]
EXCJA(-1)	-49.83285	36.64595	0.975273	0.009133	-3.323052	0.002573
	(30.2467)	(50.9924)	(0.10981)	(0.00435)	(7.12598)	(0.00587)
	[-1.64755]	[0.71865]	[8.88113]	[2.09855]	[-0.46633]	[0.43809]
EXCJA(-2)	-8.815539	-48.68620	-0.228552	-0.000709	1.978500	0.000327
	(31.5791)	(53.2387)	(0.11465)	(0.00454)	(7.43988)	(0.00613)
	[-0.27916]	[-0.91449]	[-1.99345]	[-0.15604]	[0.26593]	[0.05337]
CALLJA(-1)	458.4681	885.7380	3.346838	1.150700	107.4172	-0.063693
	(748.420)	(1261.75)	(2.71722)	(0.10769)	(176.324)	(0.14533)
	[0.61258]	[0.70199]	[1.23171]	[10.6853]	[0.60920]	[-0.43827]

CALLJA(-2)	-571.6130	-542.5059	-3.040788	-0.268474	-166.9998	-0.012173
	(708.143)	(1193.85)	(2.57099)	(0.10189)	(166.835)	(0.13751)
	[-0.80720]	[-0.45442]	[-1.18273]	[-2.63483]	[-1.00099]	[-0.08853]
STOCKUS(-1)	0.458343	0.437724	-0.000517	-2.65E-06	0.689954	0.000153
	(0.49597)	(0.83615)	(0.00180)	(7.1E-05)	(0.11685)	(9.6E-05)
	[0.92414]	[0.52350]	[-0.28725]	[-0.03715]	[5.90472]	[1.59360]
STOCKUS(-2)	-0.624394	-0.389087	0.000540	1.30E-05	0.200474	-0.000160
	(0.48094)	(0.81081)	(0.00175)	(6.9E-05)	(0.11331)	(9.3E-05)
	[-1.29827]	[-0.47987]	[0.30944]	[0.18729]	[1.76929]	[-1.71752]
FFUS(-1)	-69.58977	607.8703	-0.227630	-0.002483	24.22310	1.407933
	(501.976)	(846.272)	(1.82248)	(0.07223)	(118.263)	(0.09748)
	[-0.13863]	[0.71829]	[-0.12490]	[-0.03438]	[0.20482]	[14.4440]
FFUS(-2)	345.8146	-739.3199	2.806903	-0.037153	30.51701	-0.536649
	(516.871)	(871.384)	(1.87656)	(0.07437)	(121.772)	(0.10037)
	[0.66905]	[-0.84844]	[1.49577]	[-0.49956]	[0.25061]	[-5.34684]
C	24453.28	15555.02	43.38604	-1.416638	-319.7535	1.310572
	(6286.20)	(10597.8)	(22.8227)	(0.90452)	(1481.00)	(1.22067)
	[3.89000]	[1.46776]	[1.90100]	[-1.56618]	[-0.21590]	[1.07365]
R-squared	0.902274	0.997555	0.959097	0.987657	0.981374	0.973847
Adj. R-squared	0.886844	0.997169	0.952639	0.985708	0.978433	0.969718
Sum sq. resids	3.71E+08	1.05E+09	4884.137	7.671647	20566553	13.97178
S.E. equation	2208.044	3722.505	8.016543	0.317715	520.2043	0.428765
F-statistic	58.47397	2583.782	148.5060	506.7755	333.6868	235.8345
Log likelihood	-804.5466	-851.0304	-304.5130	-17.21135	-675.8846	-43.88948
Akaike AIC	18.37183	19.41641	7.135123	0.678907	15.48055	1.278415
Schwarz SC	18.73534	19.77992	7.498632	1.042415	15.84406	1.641924
Mean dependent	17972.99	457040.0	132.5715	2.547404	5714.400	5.331161
S.D. dependent	6564.008	69959.08	36.83639	2.657612	3542.220	2.463920
Determinant Residual Covariance		1.77E+19				
Log Likelihood (d.f. adjusted)		-2730.031				
Akaike Information Criteria		63.10182				
Schwarz Criteria		65.28287				

Impulse responses

An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables.

Based on Table 3, the impulse response function is as shown in Figure1.

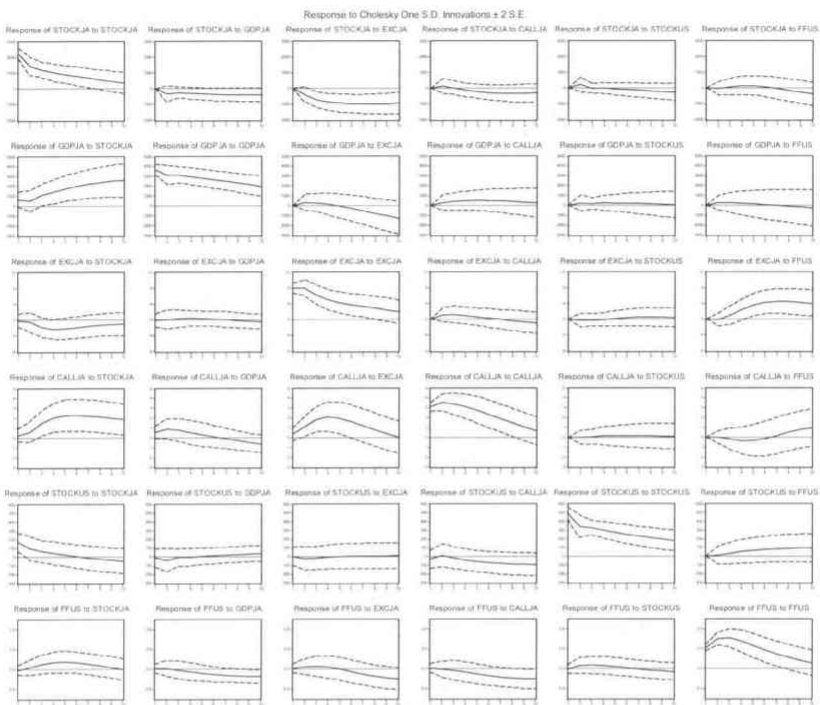

Figure 1. Impulse Response Function: Difference

The results show that the shock of GDP, call rate, and exchange rates on Japanese stock prices exists. The main result is in Figure 2.

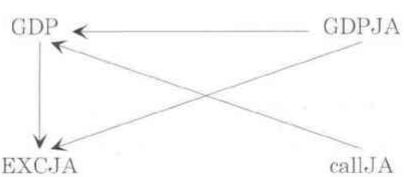

Figure 2. Impulse Response among Variables

5. Conclusion

This paper provided an empirical examination of the relationship between Japanese stock prices and macro variables.

The results show that interest rates have not influenced Japanese stock price. This finding is counter to traditional economic theory and some existing studies. The exchange rate also has not influenced Japanese stock prices. Rather than interest rates and other macro economic variables, U.S. stock prices have been highly influential on Japanese stock prices, suggesting an interdependent relationship between them.

Finally, this analysis is thought to be a reduced-form analysis. Structural model(s) in the analysis is in "black box." I offered some important and suggestive points for stock prices. However, this problem should also be considered carefully. Furthermore, it would be interesting to investigate the efficiency of stock markets in terms of 'speed' of reaction if we could get every minutes return, for example. This is, however, reserved for future study.

Notes

1. Recently, Chadha et al. (2004) stated that asset prices and exchange rates can be employed as information variables for a standard "Taylor-type" rule or as arguments in an augmented interest rate rule.
2. Stock prices and land prices increased greatly starting in 1986; however, the "bubble economy" ended in 1991.
3. Along with the previous analysis, we estimated the equations using the logarithm. However, the results were not significantly different when using this method.

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