Money and the Level of Stock Market Prices: Evidence from Japan

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Abstract

This article replicates an empirical study by Friedman (1988) that indicates the real quantity of money demanded in the United States is related positively to the lagged price of equities (termed a *wealth effect*) and related negatively to the contemporaneous real stock price (termed a *substitution effect*). Data for Japan from 1975 to 1987 suggest a similar positive relation between money demanded and lagged equity prices due to a wealth effect. For the period 1980 to 1987, support is also found for a risk-spreading effect, but not for a substitution effect.

Introduction

In a recent study, Milton Friedman (1988) investigates the relationship between money and the level of stock market prices. Using United States data from 1961 to 1986, he found evidence suggesting that the real quantity of money demanded relative to income is related positively to the deflated price of equities (lagged three quarters) and related negatively to the contemporaneous real stock price. He interpreted the positive relationship as a wealth effect and the negative relation as a substitution effect, with the wealth effect being somewhat stronger.

The motivation for Friedman's study was a chart showing a strong inverse relation between the level of the Dow Jones stock market index and the velocity of the monetary aggregate M2. He rationalized this relation in three ways (1988, pp. 222-223): (1) "A rise in stock prices means an increase in nominal wealth, and generally, given the wider fluctuation in stock prices than in income, also a rise in the ratio of wealth to income. This higher ratio is expected to be reflected in a higher money to income ratio or a lower velocity." (2) "A rise in stock prices reflects an increase in the expected return from risky assets." Although there is no guarantee that this increase in relative risk will be accompanied by a change toward risk aversion, nevertheless, a shift toward relatively safe, fixed income securities plus money may be expected. Should such a shift occur, the resultant increase in money holdings would lower velocity. (3) "A rise in stock prices may be taken to imply a rise in the volume of financial transactions, increasing the quantity of money demanded to facilitate transactions."

The above three effects may be offset by a substitution effect—"the higher the real stock price, the more attractive are equities as a component of the portfolio" (1988, p. 223). As equities become more attractive, investors would

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be expected to increase the share of equity holdings in their portfolio. This is presumed to lead to a lower money-to-income ratio and, hence, greater velocity. There may be an offsetting substitution effect, however. As noted by Barron *et al.* (1989, pp. 85-86), the rate of return on an equity share is the sum of expected dividends and expected stock price appreciation relative to the current stock price. If the current stock price rises while expected dividends and expected stock appreciation do not rise in the same proportion, the rate of return on a share falls.

Previous studies (Hamburger, 1966; Hamburger and Kochin, 1972; Hamburger and Keran 1987; Keran, 1971) of the relationship between stock market prices and money demand either have related stock prices to the volume of transactions or considered the return on securities as a variable in the money demand function. The Friedman study, however, is the first to make a direct econometric analysis of the relation between the level of stock prices and the quantity of money demanded. Although not conclusive in its findings, the Friedman study nevertheless adds to the important body of literature defining a stable money demand function.

This study tests the robustness of Friedman's results using data for Japan. Financial data on Japan since 1975 indicate an inverse relation between the level of the Nikkei stock index and the velocity of the monetary aggregate M2+CDs. (See Figures 1 and 2.) This inverse relation is analogous to that observed by Friedman for the United States. This similar relationship is of particular interest because it provides an opportunity to test further the validity of the stock price-velocity relationship. Friedman (1988, p. 232) advocated testing his conclusions with data for other countries.

The empirical evidence for Japan indicates that the velocity of money is related negatively to both the lagged price of equities and the long-short term yield ratio, suggesting both a wealth effect and risk-spreading effect as rationalized by Friedman. No evidence, however, is found to substantiate the conclusion of a significant substitution effect.

Recent Developments in the Japanese Financial System

Focusing on Japan for the post-1974 period is important for a number of reasons. First, Japan is a major industrialized country with an established equity market. Second, Japanese monetary policy is similar to that of the United States, with both the Bank of Japan and the Federal Reserve basically using interbank interest rates as their policy instruments (Dotsey, 1986). Third, the dramatic structural changes that the Japanese economy has undergone since 1973-1974 significantly have affected securities markets and demand for money.

During the 1965 to 1975 period, an era of high growth, portfolio and interest rate constraints were placed on major participants in the financial markets. Government authorities determined most interest rates, and the financial system was divided into various segments, each subject to certain borrowing and lending restrictions. These factors contributed to an underdeveloped equity market, as the private sector obtained a majority of its financing needs from financial institutions. This practice of indirect financing was a salient feature of the financial system prior to the mid-1970s, accounting for over 85 percent of the corporate sector's source of funds from 1965 to 1972 (Suzuki, 1984).

The predominance of indirect financing, with portfolio and interest rate constraints, began to fade gradually after 1974. This was a direct result of the 1973-1974 oil shock and its effect on the public sector deficit. The demand on the public sector to counter the recessionary effect of the oil shock resulted in a rapid expansion of government bonds issued. This forced monetary authorities to sanction a secondary market for government debt, a development that prevented the government from issuing fixed rate long-term bonds. The emergence of the secondary market meant that interest rates were market determined, making large denomination deposits with interest rate ceilings less attractive. This fostered shifts in deposits to higher yielding assets and stimulated an extraordinary expansion in bond trading in secondary markets.

The personal and corporate sectors also contributed to changes in the financial structure through their respective searches for higher rates of return and lower costs of borrowing. The declining investment opportunities brought by the oil shock altered the previous close relationship between the banking and business sectors. As deregulation progressed, corporations became less reliant on indirect financing for their external needs. By 1982, direct financing passing through the securities market reached nearly 15 percent (Suzuki, 1984, p. 3).

At the same time, corporations began to increase their borrowing in the international market to finance rapid expansion overseas. This alternative to borrowing in the domestic market forced banks within Japan to seek new ways to expand their lending activities and increased competition among the various segments of the banking industry. This spurred the creation in the domestic market of new financial instruments with more flexible rates of interest to compete with those from abroad.

The above developments make analysis of the relationship between stock prices and velocity in Japan, focusing on the post-1974 period, particularly relevant when one considers the extent to which the Japanese stock market expanded during the 1980s. The Nikkei stock average increased five-fold from the beginning of 1980 to the third quarter of 1989. The Tokyo capital market has

become one of the three largest financial centers of the world, along with New York and London.[1]

Empirical Implementation

For the sake of consistency, the empirical analysis corresponds to that used by Friedman. The estimated equation is:

$$(1)\quad \ln(VEL_t) = \beta_0 + \beta_1 \ln(RSP_{t-i}) + \beta_2 \ln(RSP_t) + \beta_3 \ln(L_t/S_t) + \beta_4(DY_t) + \beta_5(CALL_t) + E_t,$$

where:

$\ln(VEL_t)$ = the natural logarithm of the velocity of the Japanese money aggregate, M2+CDs.[2]

Both nominal GNP and M2+CDs are contemporaneous values for the given quarter t.[3]

Among the independent variables, ln(RSP) is the natural logarithm of the real stock price, nominal stock price (Nikkei composite) divided by a GNP deflator. The lead variable, lagged i quarters, tests for the hypothesized wealth effect. If there is a wealth effect, then the sign on the coefficient estimate for $\ln(RSP_{t-i})$ should be negative. If the substitution effect hypothesized by Friedman is present, then the sign on the coefficient estimate for $\ln(RSP_t)$ should be positive.

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[1]For a discussion of the characteristics of the Japanese stock market, see Viner (1987).

[2]The narrow definition of money (M1) in Japan is cash currency plus deposit money. The sum of M1 and time deposits yields M2. Certificates of deposit (CDs), first issued in May 1979, are taken as a form of time deposits and are included in the aggregate M2+CDs. The Bank of Japan emphasizes M2+CDs as an indicator of monetary policy because this measure is subject to a high degree of controllability (Dotsey, 1986).

[3]The dependent variable used by Friedman (1988) was nominal GNP divided by M2 two quarters earlier. Leading velocity was used to allow for the tendency for changes in money to lead changes in nominal income (1988, p. 224). For the Japanese data, however, preliminary analysis using various lagged values of M2+CDs revealed no significant differences in the estimated equations, and the highest absolute value of the correlation between velocity and stock prices was achieved with actual velocity. Thus, there is no lag on the money supply variable in this study.

The natural logarithm of the long-short yield ratio is represented by $\ln(L_t/S_t)$. The long-term yield is for ten year central government bonds, and the short-term yield is for one to three month loans and discounts by city banks.[4] This variable tests for the possibility of a shift to less risky assets. A rise in this ratio would represent a shift in demand from long-term to short-term securities, reflecting a move toward less risky nominal assets and a decrease in velocity (Friedman, 1988, p. 224).[5]

DY is a proxy for the nominal yield on real assets. As in the Friedman study, this variable is the four quarter difference between the logarithms of nominal GNP. An increase in returns on other assets (substitutes for money) is expected to decrease the demand for money and increase velocity. Thus, the predicted sign of DY is positive.

The differential yield on money, represented by CALL, is the average daily yield on call-money. The call-market is an interbank market with maturities ranging from one-half day to 21 days and is the Japanese counterpart to the U.S. federal funds market. This variable has been used consistently in studies of the money demand function as a proxy for the yield on the alternative to money (Ishida, 1984; Suzuki, 1984). Earlier studies have found the call rate to be related negatively to the quantity of money demanded, but because the independent variable in this study is velocity, the sign of the coefficient should be positive.[6]

The lead on the real stock price variable is five quarters. Correlations between various lead values of the real stock price variable and velocity yielded the highest correlation coefficient when this lead length was incorporated. In addition, this timing relation yielded higher R^2s and higher absolute t-values for the coefficients. These criteria for choosing the lag length correspond to those used by Friedman (1988).

The data for this study are quarterly observations of the given variables for the time period 1975:2 through 1987:4. Analyses are conducted on the two subperiods, 1975:2 to 1979:4 and 1980:1 to 1987:4. The two subperiods are analyzed separately to control for both the introduction of CDs and deregulation

[4]City banks are banks with headquarters in a large metropolitan area. These banks have been at the center of the private financial sector in Japan throughout the twentieth century (Suzuki, 1987). As of 1989, there were twelve city banks.

[5]The ten year government bond is the principal long-term security issued in Japan. Earlier experiments with the ratio of the yield on corporate bonds to the yield in the three month *gensaki* (repurchase agreements) market gave poor results and were abandoned.

[6]The forms taken by the independent variables correspond to those in the Friedman study. Preliminary analysis with all variables in logarithmic form yielded results almost identical to those presented here.

of interest rates in the interbank market, both of which were completed by the end of 1979.

Results

Table 1 reports the ordinary least squares estimate of the velocity equations for the 1975:2 to 1979:4 and 1980:1 to 1987:4 periods, respectively. The main finding is the negative and statistically significant coefficient of the logarithm of lead real stock prices for the two periods. These results are consistent with Friedman's hypothesis of a wealth effect leading to an inverse relationship between velocity and stock prices (Friedman, 1988, p. 230).

The noticeable differences in the regression coefficients for the two subperiods call into question the equality of the two sets of estimated coefficients. To test for the equality of the two regressions, a Chow test was conducted. An F-statistic of 5.99, statistically significant at the 1 percent level, was obtained. This indicates a shift in the function between 1979 and 1980, perhaps under the influence of structural changes in the financial system.

The regression results, however, do not support Friedman's prediction of a positive substitution effect. The estimated coefficient on the contemporaneous stock price variable is significantly negative.

A possible explanation for the absence of a positive substitution effect is specification error of the reaction speeds. Friedman noted that "if the wealth and substitution effects operate with the same reaction speeds, there is no way to isolate their separate effects" (1988 p. 232). The equations estimated in this study assume the substitution effect operates more rapidly than the wealth effect, but alternative reaction speeds cannot be dismissed.

To investigate possible differences in reaction speeds, regression equations were estimated incorporating a distributed lag formulation. By entering lagged values of the stock price variable, tests can be conducted to determine if the stock price effect is based on permanent rather than transitory components. For example, the volatility of stock prices may lead persons to respond to average stock prices over a period of time. The estimated equations for the 1980-1987 time period are presented in Table 2.[7] The positive coefficients on the real stock variable for some of the lag lengths suggest a lagged substitution effect may exist, but the low t-values do not provide statistical support for such a conclusion. The distributed lag formulation provides support for the original model in which the real stock price variable was entered with a five quarter lead.

[7]The distributed lag formulation was not applied to the earlier subperiod due to a lack of degrees of freedom.

The coefficient on this variable becomes significant at lags of four and five, consistent with the findings of the original specification of the equation.

An alternative explanation for the consistent negative sign on the contemporaneous real stock variable is the presence of a negative substitution effect, as discussed earlier. If such an effect exists, the wealth and substitution effects work in the same direction and cannot be separated. Although share prices in Japan have risen over time, dividend yields have not. In the 1970s, yields averaged 2 percent to 3 percent, but from 1980 to 1985 the average yield declined from 2 percent to 1 percent, further dropping to 0.69 percent at the end of 1986.[8] Because the rate of return on equity shares includes the expected dividend, this decline in expected dividend yield may outweigh the effect of an increase in expected stock appreciation. The extent to which stock prices have appreciated relative to the decline in dividend yields, however, appears to eliminate this possibility.

Among the other independent variables, perhaps the most notable result is the statistically significant negative coefficient on the long-short yield variable for the 1980 to 1987 period. As stock prices rise, there appears to be a shift toward short-term and away from long-term securities. Although the U.S. data did not support Friedman's hypothesis of a risk-spreading relationship, the significant negative sign using Japanese data indicates such an effect may exist. Finally, turning to the yield variables, both the differential yield (CALL) and the proxy for nominal yield on real assets (DY) have the expected sign and are significant for the latter time period.[9]

Conclusion

This study has investigated the effect of real stock prices on the velocity of the Japanese monetary aggregate M2+CDs. The results support the existence of both wealth and risk-spreading effects. The wealth effect is indicated by the negative relationship between velocity and the lagged real stock price. The risk-spreading effect of a rise in real stock prices (an increase in risky assets relative

[8]Viner (1987) claims taxation is one reason for the low yield of dividends in Japan. Domestic institutional investors are taxed on capital gains. Individual investors are taxed only in certain cases, which in effect yields no capital gains tax for individuals. Dividends, however, are taxed as income, which encourages investors to neglect dividends as a source of income and seek capital gains through turnover instead (Viner, 1987, p. 91).

[9]The somewhat puzzling results for the yield variables for the earlier time period may be attributable to the artificially low interest rate policies that remained in effect until the latter 1970s. Deregulation of short-term interest rates in Japan has progressed slowly even into the 1980s. See Suzuki (1984, 1987).

to safe assets) appears to reflect a desire for income earners to shift to relatively safer short-term securities plus money. Contrary to the finding of Friedman, however, no evidence of a positive substitution effect is found.

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Table 1
Regression of Logarithm of Velocity of M2+CDs on Real Stock Price and Other Variables for Periods 1975:2-1979:4 and 1980:1-1987:4

Independent Variable	1975:2-1979:4[a] Coefficient[c] (t-value)	1980:1-1987:4[b] Coefficient (t-value)
Constant	-1.98 (-62.68**)	-2.21 (-155.70**)
Ln(RSP) (5-qtr. lead)	-.15 (-2.42*)	-.09 (-6.35**)
Ln(RSP) (no lead)	-.54 (-3.88**)	-.75 (-2.14*)
Ln(L/S)	-.15 (-.80)	-.08 (-2.14*)
DY	-.69 (-2.90*)	.58 (4.01**)
CALL	-.09 (-3.71**)	.006 (5.11**)
Serial Correlation (Rho)	-.759	
Adjusted R^2	.640	.960
F-value[d]	25.00*	120.84**
Durbin Watson Statistic	2.93[c]	2.04
Standard error of estimate	.013	.008

[a] The number of observations for the 1975:2-1979:4 period is 19 for the OLS estimates (not presented) and 18 for the Cochrane-Orcutt estimate
[b] The number of observations for the 1980:1-1987:4 period is 32
[c] The regression results include the Cochrane-Orcutt correction for serial correlation
[d] The F-value tests the significance of the regression effect
[e] The Durbin-Watson statistic is for the OLS estimates
* significant at the 5 percent level
** significant at the 1 percent level

Sources: The money supply and national income variables are taken from Bank of Japan, *Economic Statistics Annual* (1975-1988). Interest rate variables are found in Bank of Japan, *Economic Statistics Monthly* (1975-1988). The price index is taken from OECD, *Main Economic Indicators* (1975-1988), and the stock price indexes are available from Japan Ministry of Finance *Monthly Financial Review* (1975-1988)

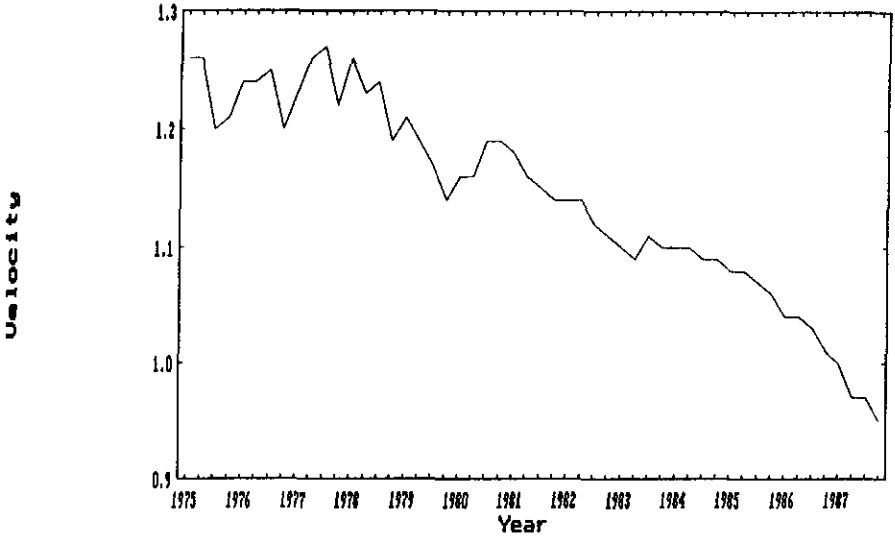
Table 2
Regression of Logarithm of Velocity of M2+CDs on Lagged Real Stock Price Values and Other Variables Time Period—1980:1-1987:4[a]

Independent Variable	Coefficient (t-value)	Coefficient (t-value)	Coefficient (t-value)
Constant	-2.22 (-96.75**)	-2.20 (-120.46**)	-2.21 (-127.79**)
Ln(RSP)	.017 (.27)	-.005 (-.121)	.011 (.249)
$Ln(RSP)_{t-1}$	-.071 (-.890)	.04 (.605)	.011 (.169)
$Ln(RSP)_{t-2}$	.009 (.130)	-.10 (-1.76#)	-.004 (-.064)
$Ln(RSP)_{t-3}$	-.052 (1.25)	.09 (1.72)	.004 (.054)
$Ln(RSP)_{t-4}$		-.13 (-3.81**)	-.90 (-.451)
$Ln(RSP)_{t-5}$			-.076 (-2.193*)
Ln(L/S)	-.062 (-1.04)	-.130 (-2.54**)	-.089 (-1.80#)
DY	.680 (3.23**)	.620 (3.65**)	.559 (3.36**)
CALL	.005 (2.74**)	.005 (3.63**)	.006 (4.37**)
Adjusted R^2	.928	.948	.950
F-value[b]	52.58**	63.70*	56.20*
Standard error of estimate	.012	.010	.009

a The number of observations is 32
b The F-value tests the significance of the regression effect
\# significant at the 10 percent level
* significant at the 5 percent level
** significant at the 1 percent level

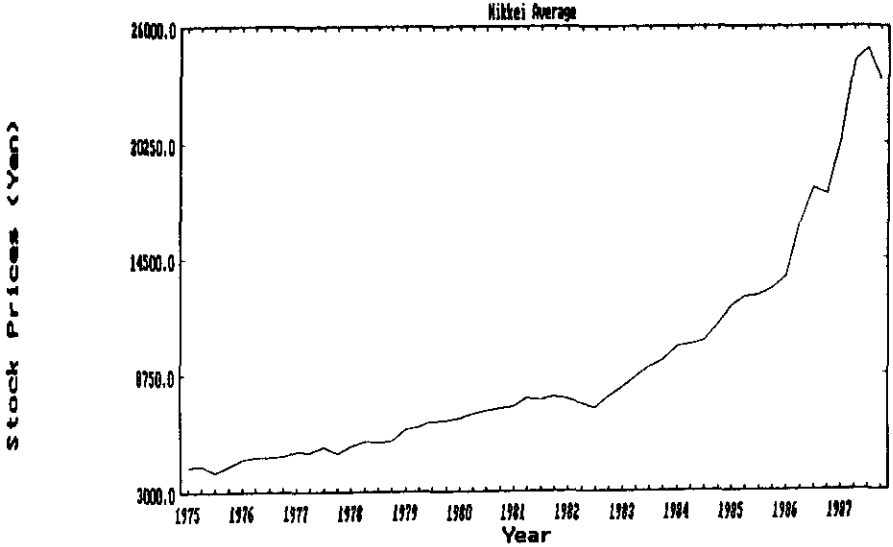
Sources: The money supply and national income variables are taken from Bank of Japan, *Economic Statistics Annual* (1975-1988). Interest rate variables are found in Bank of Japan, *Economic Statistics Monthly* (1975-1988). The price index is taken from OECD, *Main Economic Indicators* (1975-1988), and the stock price indexes are available from Japan Ministry of Finance *Monthly Financial Review* (1975-1988)

Figure 1
Velocity of M2+CDs



The money supply variable and income variable are taken from Bank of Japan, *Economics Statistics Annual.*

Figure 2
Stock Prices
(Nikkei Average)



The stock price index is found in Japan Ministry of Finance, *Monthly Financial Review*