

# Asset Price and Monetary Policy: The Japanese Case

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## Abstract

After the Bank of Japan (Japanese central bank) introduced unprecedented monetary policy in March 2011, it continuously conducted aggressive monetary policy to boost the economy. Moreover, it started to conduct stronger monetary policy in January 2013. It planned to double the monetary base to combat deflation and promote economic growth. The effectiveness of this large and unprecedented monetary base rule, which is not interest rate as used in traditional monetary policies targeted to boost the economy, has received much attention not only in Japan but also all over the world. This article empirically examines whether or not this monetary base rule would have achieved stock price rising in Japan. The results show no relationship between stock prices and monetary policy. The effect of monetary base expansion on Japanese stock prices was not found. Stock prices and exchange rates in the United States, on the other hand, have had significant effects on Japanese stock prices.

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**Keywords:** Bank of Japan, monetary policy, quantitative easing, stock price

## 1 Introduction

This article provides the results of an empirical investigation of the relationship between recent Japanese stock prices and macroeconomic variables, namely, monetary base and US stock prices. Japan experienced a period of unprecedented recession and deflation for more than 20 years. During that period, the Bank of Japan (BOJ: Japanese central bank) conducted monetary easing at an unprecedented level. One of the purposes of BOJ's policy was to influence stock price, although the BOJ has not admitted to this purpose as have other central banks. The governor of the BOJ has reiterated the importance of increasing the transfer of funds from safe to so-called risky assets. The quantitative monetary easing policy seems to be strongly related to this purpose. There is much dispute over whether or not quantitative easing has been effective [1]. More recently, in April 2013, Japan introduced unprecedented and more aggressive monetary policy. The BOJ doubled the

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monetary base to promote economic growth. On the other hand, the relationship between stock prices and monetary base has not been adequately examined.

This paper analyzes the macroeconomic factors of stock prices in Japan. To determine the relationship of stock prices to monetary policy, this factor is included in the analysis. All over the world, the most important factor in determining stock prices has been interest rates. It is natural and rational to think that interest rates strongly impact on stock prices. However, in Japan, market interest rates have been close to zero since the quantitative monetary easing policy began in 2001. Long-term Japanese government bonds' nominal yields initially declined and have stayed low [2]. Along with other macroeconomic variables that are related to stock prices, the relationship between stock prices and monetary policy should be analyzed; however, few studies have analyzed this relationship.

Section 2 reviews the relationship between the stock markets and macroeconomic variables. Section 3 provides the theoretical framework for the analysis, followed by application of the empirical method and analysis of the deterministic elements of stock prices in Japan in section 4. Finally, this article ends with a brief summary.

## 2 Existing Studies

The relationship between stock prices and macroeconomic variables has been disputed all over the world. Campbell (1987), Cutler et al. (1989), and Hodrick (1992) Some studies have found that short-term and long-term interest rates have a small degree of forecasting power for excess stock returns [3, 4, 5]. Other studies (e.g., [6, 7]) have shown that the term structure of interest rates helps to forecast excess stock returns. Others (e.g., [8, 9]) have found that short-term interest rates affected stock prices.

The factors that influence stock prices, including interest rates, change over time. For example, in the 1970s and early 1980s, inflation rates were high, which in turn affected stock prices. Since then, in general, interest rates have continued to have much influence on stock prices. However, this study analyzes the period since March 19, 2001, when quantitative monetary easing was implemented in Japan. It is uncertain whether the interest rate has had an effect on stock prices since then.

Little research exists on the effect of the exchange rate on stock prices. [10] investigated this relationship and found that the effect of changes in the exchange rate was insignificant for Japan, but [11] provided evidence that the exchange rate is an important factor. Since the 1980s, capital movement across countries has been dramatic. In spite of the reduction in fluctuations of the exchange rate in the 1990s compared to the 1980s, this movement should not be ignored. There still exists some possibility that exchange rates have been influencing Japanese stock prices. Japan introduced unprecedented aggressive monetary policy in April 2013, and some believe the policy has led to yen appreciation. This is called Abenomics (Abe is the prime minister's name).

[12] suggested that Abenomics will likely continue to stimulate this effect. However, the size of this effect, while highly uncertain, thus far appears likely to fall short of Japan's large output gap. In part, this is because the BOJ's 2% inflation target is not yet fully credible. Recently, [13] showed that government policies have failed to lift Japan's GDP to the expected level. The influence of macroeconomic variables and the relationships among them have been changing constantly, as noted above. Under such circumstances, much more analysis is important.

### 3 Theoretical Framework

The model for this paper is as follows. First, stock price PS is the sum of two components: the fundamental one, PF, and the non-fundamental one, PB. PS is a value of the stock prices. The fundamental component is defined as the discount value of D.

$$PF_t = E_t \left[ \sum_{k=1}^{\infty} \prod_{j=0}^{k-1} \left( \frac{1}{R_{t+j}} \right) D_t + k \right] \quad (1)$$

R is an interest rate. t denoted time. This equation (1) is converted into a log form:

$$p_{ft} = \text{const.} + \left[ \sum_{k=0}^{\infty} \Lambda k [(1 - \Lambda) E_t \{dt + k + 1\} - E_t(r_{t+k})] \right] \quad (2)$$

Using equation (2), the predicted response of the fundamental component is expressed as follows:

$$\frac{\partial p_{st+k}}{\partial \varepsilon_{mt}} = (1 - \gamma_{t-1}) \frac{\partial p_{ft+k}}{\partial \varepsilon_{mt}} - \gamma_{t-1} \frac{\partial p_{st+k}}{\partial \varepsilon_{mt}} \quad (3)$$

$\gamma$  denotes the share of the bubble in the price at time t. The equation (3) is a stock price change in response to a monetary policy, m.

This calculation starts with the unit root tests of all of the variables considered and uses an Augmented Dickey-Fuller (ADF) and PP 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, as this violates the assumption of white noise disturbance.

Following the ADF and statistical test, the present approach uses a cointegration test. It is known that a linear combination of two or more nonstationary time series may be stationary. If such a stationary linear combination exists, the nonstationary time series is said to be cointegrated. The stationary linear combination is interpreted as a long-run equilibrium relationship among the variables.

The next step is the analysis of 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.

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 has indicated that an increase (or decrease) in the interest rate usually induces the decline (or increase) of stock prices. However, empirical studies have provided many kinds of results as mentioned above. 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, the movement of exchange rates should be taken into account instead in this study. The analysis, considering each relationship, is too complex. It is difficult to determine whether the effect of changes in the exchange rate is positive or negative. In this paper, interest rates are omitted. The main reason is that stock prices react more quickly than interest rates, sometimes immediately. Simultaneous estimation of interest rates and

monetary policy at the same time has problems. Moreover, interest rates in Japan have been too complex to evaluate. On the other hand, we can say clearly, however, that in an export-oriented country such as Japan, depreciation of the currency increases exports as well as stock prices. Also, US stock prices are included for estimation.

## 4 Empirical Analyses

As mentioned above, one purpose of this study is to analyze stock prices in Japan since the quantitative easing policy was implemented on March 19, 2001.

First, unit root tests of each macroeconomic variable related to stock prices are conducted. The variables estimated are monetary base of Japan, Japanese stock price, US stock price, and exchange rate (yen/US dollar). The test method is ADF. The sample period is between 2001:April and 2014:December. If the variables have unit roots, the one-time difference of each variable can be used instead. The results of one-time difference are shown in Table 1.

Table 1 Unit root test (ADF)

	t-statistic	Probability
Monetary base	2.786	0.008
Japanese stock price	-1.889	0.065
US stock price	-2.758	0.007
Exchange rate	-1.752	0.087

Table 1 reports the results of one-time difference as all of the original ones have unit roots. All of the results are not significant at the 1% level; however, all of them are significant at the 10% level. From this result, it can be stated that the Japanese stock prices regressed as a result of changes in the monetary base, Japanese stock price, US stock price, and exchange rate. The equation to be estimated is (4);

$$\log\Delta\text{stock} = \alpha_0 + \alpha_1\log\Delta\text{MB} + \alpha_2\log\Delta\text{USstock} + \alpha_3\log\Delta\text{EXC} \quad (4)$$

Stock denotes Japanese stock price index (Nikkei225), MB denotes monetary base, US stock denotes US stock price (DOW), and EXC denotes exchange rate (yen/US dollar). All of the variables are averages for the period. Data are monthly and are from International Financial Statistics (IMF). Moreover, the different sample period case, namely, from 1990 to 1999, is examined for comparison. Empirical methods are OLS and robust estimation. Robust estimation is unlike maximum likelihood estimation. OLS estimates for regression models are highly sensitive to outliers, or observations that do not follow the pattern of the other observations. This is not a problem if the outlier is simply an extreme observation from the tail of a normal distribution; however, if the outlier is from non-normal measurement error or some other violation of standard OLS, it compromises the validity of the regression results if a non-robust regression method is employed. The results are shown in Tables 2a and 2b.

Table2a: Deterministic elements of the Japanese stock prices: 2001 (April)–2014

	OLS		Robust Estimation	
	Coefficient	Prob.	Coefficient	Prob.
C	-1.537 (-4.129)	0.002	-1.870 (-6.295)	0.000
MB	-0.086 (-0.955)	0.344	-0.117 (-1.634)	0.102
USstock	0.664 (9.425)	0.000	0.658 (11.708)	0.000
EXC	1.231 (10.254)	0.000	1.439 (15.024)	0.000
Adj.R2	0.790		0.916	
F-statistic/Rn-squared statistic	62.713		362.801	
Prob (F-statistic/Rn-squared statistic)	0.000		0.000	
Durbin-Watson	0.351			

Note. Figures in parentheses are t-statistic/z-statistic.

Table2b: Deterministic elements of the Japanese stock prices: 1990 - 1999

	OLS		Robust Estimation	
	Coefficient	Prob.	Coefficient	Prob.
C	3.433 (3.412)	0.006	3.424 (2.857)	0.004
MB	-0.112 (-0.509)	0.621	-0.120 (-0.459)	0.645
USstock	-0.510 (-7.229)	0.000	-0.498 (-5.921)	0.000
EXC	-1.019 (-3.595)	0.004	-0.996 (-2.949)	0.003
Adj.R2	0.849		0.896	
F-statistic/Rn-squared statistic	25.481		51.082	
Prob (F-statistic/Rn-squared statistic)	0.000		0.000	
Durbin-Watson	2.326			

Note. Figures in parentheses are t-statistic/z-statistic.

The results of equations are not so clear, but they explain some interesting and important points. First, after adoption of quantitative easing, depreciation of yen promoted increases in Japanese stock prices. Japanese companies could increase exports, which might lead to increases in Japanese stock prices. On the other hand, appreciation of the yen negatively impacted stock prices. Second, US stock prices were positively related to Japanese stock

prices during the quantitative easing period; however, they have negative impacts on Japanese stock prices during the 1990s. Finally, there is one common element. The monetary base did not affect the Japanese stock price in both periods.

Moreover, a linear combination of two or more non-stationary series are said to be cointegrated. The stationary linear combination may be interpreted as a long-run equilibrium relationship among the variables. The purpose of the cointegration test is to determine whether or not a group of nonstationary series is cointegrated. This section provides an unrestricted cointegration test. The lag interval is two, according to the Akaike Information Criterion (AIC) test. AIC can choose the length of a lag distribution by choosing the specification with the lowest value of the AIC. The sample period is after quantitative monetary easing. The results show the cointegration of trace test indices at 5%, which confirms that Japanese and US stock prices can be interpreted as having a long-run equilibrium relationship between the variables. Both variables are nonstationary. Note, however, that the relationship between the two variables is significant. Rising US stock prices influenced the Japanese stock prices during quantitative easing period as previously confirmed.

Vector autoregressions (VARs) are employed for further analysis. The method employed here is mainly used to forecast systems of interrelated time series and to analyze the dynamic impact of random disturbances on the employed variables. Empirical estimation and interface are complicated by the fact that endogenous variables may appear on both the left and right sides of equations. The simultaneous use of a VAR avoids this issue. The macroeconomic variables are structurally correlated, with different possible lags. Therefore, a VAR model is used to examine the data to avoid this issue. The result is shown in Table 3.

Table 3: VAR Estimates

	Jstock	MB	USstock	EXC
Jstock(-1)	0.912 (3.903)	-0.000 (-0.000)	0.444 (1.829)	0.081 (0.767)
Jstock(-2)	0.112 (0.492)	-0.129 (-0.797)	-0.041 (-0.175)	-0.005 (-0.056)
MB(-1)	0.167 (0.750)	0.986 (6.183)	0.457 (1.964)	0.038 (0.379)
MB(-2)	-0.018 (-0.070)	0.072 (0.385)	-0.382 (-1.439)	0.038 (0.330)
USstock(-1)	0.225 (1.230)	-0.019 (-0.151)	0.924 (4.849)	-0.106 (-1.285)
USstock(-2)	-0.394 (-2.310)	0.112 (0.924)	-0.323 (-1.825)	0.046 (0.605)
EXC(-1)	0.348 (0.845)	0.015 (0.053)	-0.576 (-1.346)	1.058 (5.669)
EXC(-2)	-0.398 (-0.939)	0.073 (0.242)	-0.032 (-0.073)	-0.198 (-1.031)
C	0.080 (0.181)	-0.204 (-0.644)	1.024 (2.213)	0.084 (0.416)
Adj.R2	0.884	0.907	0.886	0.926
F-statistic	46.108	58.918	39.138	74.575
Akaike AIC	-3.523	-4.200	-3.445	-5.104

Note. Figures in parentheses are t-statistics.

Impulse responses are performed based on this study. 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. For stationary series, the impulse responses should die out to zero and the accumulated responses should be constant. Based on the equation, the impulse response function is as shown in Figure 1.

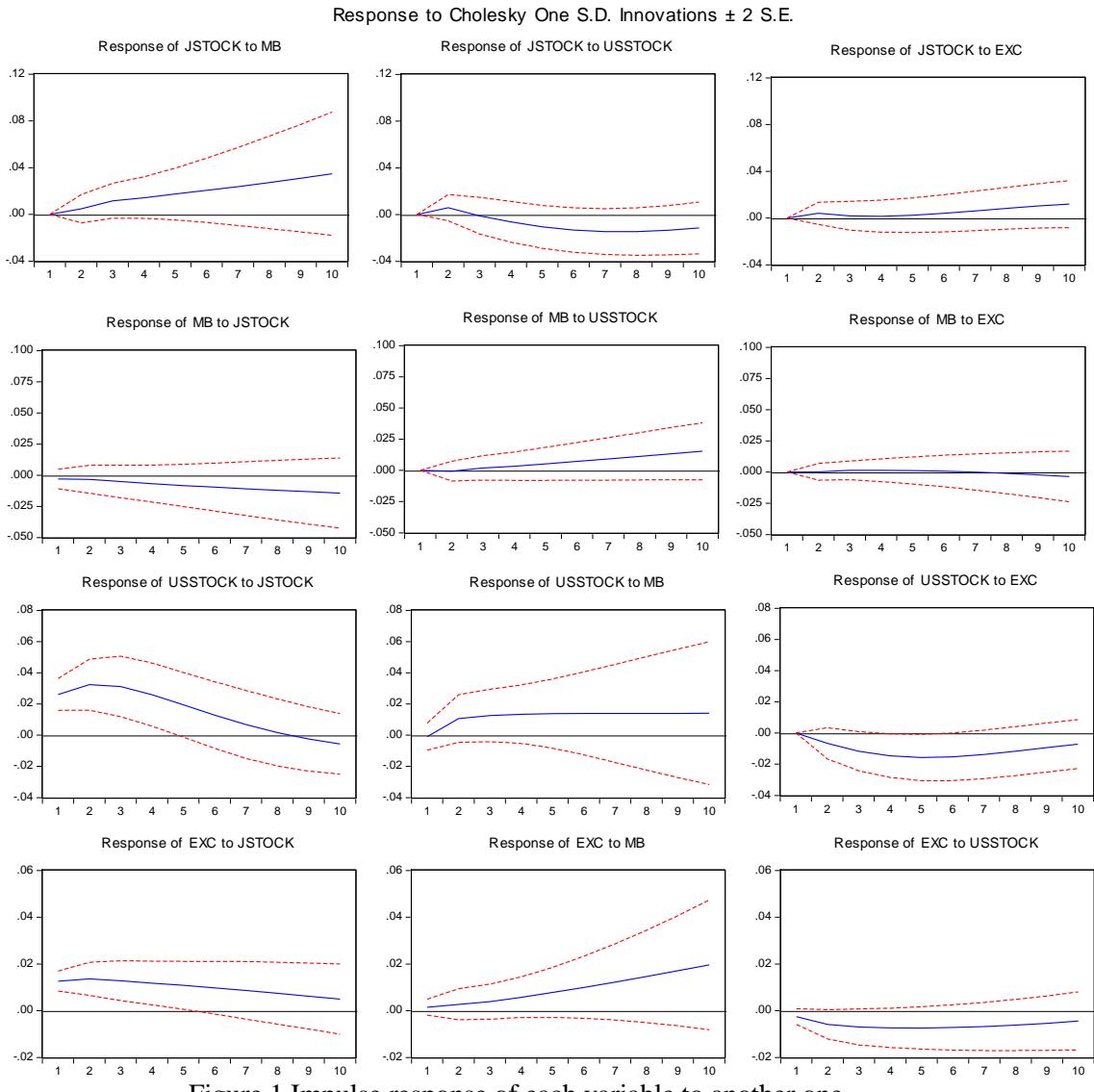


Figure 1 Impulse response of each variable to another one

The results show that when US stock prices rise, Japanese stock prices also rise hugely. However, the shock fades in a few months or so. On the other hand, depreciation of the yen continues longer than the case of US stock prices and leads to rises in Japanese stock prices. Granger causality tests are performed to check the relationship among variables. The results are shown in Table 4 and coincide with the previous estimations.

Table 4 Pairwise Granger causality tests

Null Hypothesis	F-Statistic	Probability
MB does not Granger Cause JSTOCK	4.788	0.033
JSTOCK does not Granger Cause MB	1.874	0.177
USSTOCK does not Granger Cause JSTOCK	0.489	0.487
JSTOCK does not Granger Cause USSTOCK	0.009	0.921
EXC does not Granger Cause JSTOCK	0.064	0.800
JSTOCK does not Granger Cause EXC	0.040	0.838
USSTOCK does not Granger Cause MB	0.005	0.942
MB does not Granger Cause USSTOCK	4.545	0.038
EXC does not Granger Cause MB	0.691	0.409
MB does not Granger Cause EXC	3.705	0.060
EXC does not Granger Cause USSTOCK	1.308	0.258
USSTOCK does not Granger Cause EXC	0.001	0.967

Finally, the durations of macroeconomic shocks to Japanese stock prices are checked. First, the equation is estimated based on the OLS equation (5).

$$\text{residuals} = c + \beta \text{residuals}(-1) + \varepsilon \quad (5)$$

The coefficient of  $\beta$  is 0.774. The duration scale is defined as half (0.5) and the duration period when the shocks become half.  $\log 0.5 / \log 0.774$  is calculated. The result is 2.71, indicated that the macroeconomic shock continues 2.71 months. The evaluation is difficult; however, the period is shorter than a quarter and thus seems adequate.

## 5 Conclusion

This reports on an empirical examination of the relationship between the Japanese stock prices and macroeconomic variables during the time of the quantitative easing policy.

The results indicate that the monetary base does not influence Japanese stock prices. It could also be concluded that exchange rate depreciation does influence Japanese stock prices. More than other macroeconomic variables, US stock prices have had a strong positive influence on Japanese stock prices, which suggests an interdependent relationship between them. Japanese companies have had strong ties with the US economy and have been dependent on it according to news sources. However, the results were contrary for the 1990s. There is also a long-term stable relationship between the two variables. When US stock prices rise, Japanese stock prices rise the following month and the shock fades shortly; however, exchange rate shocks continue for a much longer time.

Exchange rates seem to be an effective way to boost stock prices; however, most of the central banks all over the world do not manipulate stock prices. It also should be noted that import companies sometimes have been damaged by this.

## References

- [1] Y. Kurihara, “Recent Japanese monetary policy: An evaluation of the quantitative easing,” *International Journal of Business*, vol. 11, no. 1, 2006, pp. 79–86.
- [2] A. Tanweer and D. Anupam, “Understanding the low yields of the long-term Japanese sovereign debt,” *Journal of Economic Issues*, vol. 48, no. 2, 2014, pp. 331–340.
- [3] Y. Campbell, “Stock returns and the term structure”, *Journal of Financial Economics*, vol. 18, no. 2, 1987, pp. 373–399.
- [4] D. M. Cutler, J. Poterba and L. Summers, “What moves stock prices”, *Journal of Portfolio Management*, vol. 15, no. 3, 1989, pp. 4–12.
- [5] R. J. Hodrick, “Dividend yields and expected stock returns, alternative procedures for inference and measurement,” *Review of Financial Studies*, vol. 5, no. 3, 1992, pp. 357–386.
- [6] Y. Campbell and J. Shiller, “Yield spreads and interest rate movements: A bird’s eye view,” *Review of Economic Studies*, vol. 58, no. 3, 1991, pp. 495–514.
- [7] E. F. Fama, “The information in the term structure,” *Journal of Financial Economics*, vol. 13, no. 4, 1984, pp. 509–528.
- [8] Y. Campbell, and J. Ammer, “What moves the stock and bond markets? A variance decomposition for long-term asset returns,” *Journal of Finance*, vol. 48, no. 1, 1993, pp. 3–37.
- [9] S. Hamori and Y. Honda, “Interdependence of Japanese macroeconomic variables,” *International Advances in Economic Research*, vol. 20, no. 1, 1991, pp. 23–31.
- [10] Y. Hamao, “An empirical examination of the arbitrage pricing theory: Using Japanese data”, *Japan and the World Economy*, vol. 1, no. 1, 1988, pp. 45–61.
- [11] J. J. Choi, T. Hiraki and N. Takezawa, “Is foreign exchange rate risk priced in the Japanese stock market,” *Journal of Financial and Quantitative Analysis*, vol. 33, no. 3, 1998, pp. 361–382.
- [12] J. K. Hausman, J. F. Wieland, B. Bernanke and P. Krugman, “Abenomics: Preliminary analysis and outlook,” *Brookings papers on Economic Activity*, 2014, pp. 1–76.
- [13] T. Hayashi 2014, “Is it Abenomics or post-disaster recovery?” *International Advances in Economics Research*, vol. 20, no. 1, 2014, pp. 23-31.