Do Volatility Indexes and Historical Volatility Influence Stock Prices? The Japanese Case

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Abstract

This paper examines the relationship between Japanese stock prices and two volatility indexes. In Japan, a drastic monetary policy, Abenomics, designed to combat serious and continued deflation has been conducted since 2013. The two time periods, before and after the policy, are analyzed and compared in this study. Empirical results show that there is no difference between the two periods for volatility indexes on Japanese stock prices, however, the impact of historical volatility (HV) changes on stock prices differs largely between before and after Abenomics. As HV decreases, markets move from bearish to bullish and predict stock prices to rise after the introduction of drastic economic policies. Interest rates have a negative impact on stock prices, and currency depreciation promotes stock price rising after conducting Abenomics.

1. Introduction

This paper examines the relationship between Japanese stock prices and two volatility indexes of stock prices. In Japan, serious and continued deflation has prevailed and damaged the economy, so a drastic policy, Abenomics, has been conducted since 2013 by the new political regime. Japan enjoyed high economic growth rates in the middle of the 1980s, and stock and land prices rose

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tremendously. It was called a bubble economy in Japan. The Japanese yen appreciated, but exports that have traditionally been negatively related to yen appreciation in Japan did not reduce. As consumer prices also did not rise severely, households were not damaged, so a recession did not occur. However, the bubble economy. during which stock prices rose, suddenly stopped and burst at the beginning of the 1990s. After that, the Japanese economy recovered gradually, but Japan experienced a serious recession in the 1990s. The weak Japanese financial system and structural problems, such as delays in reforms and deregulation in many fields in Japan, are what caused the recession.

The Japanese government, of course, conducted policies to boost the economy. In March 2001, the Japanese central bank, the Bank of Japan (BOJ), conducted a new and drastic monetary policy called the quantitative easing policy. The BOJ quit the quantitative easing in 2006 as there were signs that the economy was recovering from the serious situation, namely, deflation and recession. However, the Japanese economy had not attained high enough economic growth. An unfortunate worldwide crisis occurred around 2008 that damaged the world economy, the economies of other countries, and the Japanese economy.

A change of regime (government) occurred at the end of 2012, and the Japanese government switched to a new policy called Abenomics. Abe is the name of Japan's prime minister, and he is the namesake for this economic policy. Abenomics is constituted by three arrows or principles: (1) aggressive monetary policy, (2) fiscal consolidation, and (3) growth strategy. In April 2013, the BOJ and the Japanese government announced a joint statement. At that time, under huge accumulated debt, the Japanese government wanted to or needed to depend on and conduct more aggressive monetary policy instead of fiscal policy because of the expanding debt. The BOJ began to conduct expanded monetary policy based on the principles that the policy shall be aimed at achieving price stability. This new policy contributed to the sound development of the Japanese economy, and overcoming deflation was the most important goal for the government. The government would boost Japan's economy by conducting flexible macroeconomic policies and by conducting measures to strengthen the competitiveness and potential growth of the Japanese economy. By promoting cooperation between the government and the BOJ, the government would conduct measures for the establishment of a sustainable fiscal structure to ensure the credibility of fiscal management (Cabinet Office, Ministry of Finance, and Bank of Japan, 2013). In reality, the Japanese political regime change at the end of 2012 made economic policies aggressive in both monetary and fiscal policies.

The purpose of this paper is to examine deterministic factors of the stock prices in Japan before and after Abenomics particularly with regard to two volatility indexes and macroeconomic variables. There are few studies that focus on the relationship between volatility indexes and stock prices. Also, there are some excellent studies regarding the relationship between macroeconomic variables and stock prices, however, there are only a few studies that analyze the Japanese cases. After the regime and policy changes under Abenomics, there are few studies that

address these topics.

Following this section, section 2 reviews related existing studies with this study. Section 3 analyzes the relationship between stock prices and other variables that would impact the Japanese stock prices including volatility indexes. Based on the analyses of section 3, empirical analyses are performed, and a presentation of the results is section 4. Finally, a brief summary of this study is performed.

2. Related Existing Studies

During the 1980s and 1990s, many researchers analyzed the relationship between stock prices and interest rates. The relationship between stock prices and macroeconomic variables has been examined in the past. Interest rates have some forecasting impacts on stock returns [1][2][3][4][5]. Also, short-term interest rates have been found to affect stock prices [6][7]. However, interest rates in Japan have been quite low since the 2000s, so it is possible that different and unpredicted phenomena have been occurring.

Little research has been performed about the effect of the foreign exchange rates on stock prices. This relationship showed that the exchange rate on stock prices was not significant for the case of Japan [8], but it was also reported that the exchange rate was the dominant factor on stock prices [9]. Market participants analyzed foreign assets of companies and responded to changes in foreign exchange rates [10]. It was also found that hedging by using some kinds of derivatives can reduce the noise in corporate earnings [11][12]. Since the 1980s, the movement of capital across countries has increased because of regulations in the world, so the impact of the movement on stock prices must not be ignored. It is possible that exchange rates have been influencing the Japanese stock prices much more than in the past. Instead of rather low Japanese interest rates, exchange rates could impact stock prices.

This paper focuses on volatilities of stock prices as deterministic factors. Rising stock indexes of risky assets increases the volatility of the index [13]. The case of Dhaka stock market showed that the volatility of the stock return and the jump probability became higher after 2001 [14]. Over-sell and over-buy rates of foreign capital influence the movements of stock price indexes and the exchange rates [15]. It has been indicated that the return of Korean stock market does not predict the VKOSPI (Korean representative implied volatility index) [16]. The relationship between implied volatility and stock prices for five main European stock markets was explored, and it was found that implied volatility indexes are linked with stock market volatilities of the future.

For the case of trading volumes of stocks, there are some studies available. A positive relationship between trading volume and the stock price change has been discussed [18]. It has also been shown that stock trading volume and exchange rate are related to stock prices respectively [19]. The Taiwan Volatility Index causes the order of options [20]. The conditional standard deviation was found to

be negatively related to the level of the Dhaka stock market returns [21]. The volatility index and bond spread each have an impact on exchange rates [22].

Finally, in academic fields, most studies have been performed using rates of prices instead of levels when analyzing stocks. In the academic world, it has always been important to consider rates. ROA (Return on Assets) and ROE (Return on Equity) are typical examples for the case of stock prices, and the rate is used for businesses. On the other hand, investors watch levels (the difference between the selling price and the buying price). Levels of stock prices instead of rates seem to be important for stock price determinations. Most investors look at levels of stock prices instead of the rates when they trade in the stock markets. The difference between the selling price and the buying price is important.

3. Indexes of Volatilities and Macroeconomic Variables

Economic theory has conferred some concepts about the relationship between macroeconomic variables and stock prices. Stock prices are influenced by dividends, future expected prices, and macroeconomic variables. Traditional studies show that an interest rate increase (decrease) usually causes a decline (increase) in stock prices. However, some empirical studies have shown various results, and the results seem to be not so robust and complex. For example, when the economic condition is too strong, the effect of rising interest rates on stock prices is limited and can be related positively to stock prices. In the case of foreign interest rates, the influence on domestic stock prices is more complicated. Usually, rising foreign interest rates cause a decrease in that country's stock prices, and it leads to the decrease of domestic stock prices. However, there is some possibility that depreciation of domestic currency by high foreign interest rates may increase domestic stock prices.

In general, the most important element in determining stock prices has been interest rates across the world. However, in Japan and other countries including the United States, interest rates have almost been zero since the introduction of the monetary easing policy. In Japan, minus zero interest rates have been introduced. The effect of interest rate changes on stock prices has been decreasing under the situation and it could become very low. There may also be other macroeconomic factors that have impacts on stock prices.

For exchange rates, depreciation of domestic currency is considered to promote rising stock prices in an export-oriented country such as Japan. Depreciation of the currency increases exports and leads to stock prices rising of primarily exporting companies. Considering situations where large volumes of capital move primarily for international trade and for capital investment is important for analyzing recent stock prices fluctuations. Exchange rate movement consideration seems to be inevitable when analyzing stock prices.

This study uses two volatility indexes. One is the Nikkei Stock Average Volatility

Index (VI). It is the expected degree of fluctuations of the Nikkei Stock Average in one month. Concretely, taking near-term future prices, the volatility of near-term options and next-term options are calculated by linear interpolation or linear extrapolation between the volatilities of each delivery month to make the time to expiration as 30 days. The rising of VI promotes short-sell and re-purchase of stocks in the future. Also, risk avoidance should be considered. Therefore, VI and stock prices are usually negatively related.

The other index is Historical Volatility (HV) on Nikkei 225. It is calculated from daily returns for the past 20 days. It is a statistical measure of the dispersion of returns for a given security or market index over a given period of time. The relationship between HV and stock prices is difficult to judge. The stability of the HV could promote opposite directions on stock prices. One is that stability (i.e., the decreasing of the index) promotes rising stock prices as market participants predict stock prices to rise in some time. In this case, the coefficient is minus. On the other hand, stability brings stock price decline if the decreasing of HV is not so large or is not enough. In this case, the coefficient is plus. The appropriate answer has to depend on empirical analyses. Based on this consideration, empirical analyses are performed in the next section.

4. Empirical Analysis

4.1 Unit Root Test

First, unit root tests of each macroeconomic variable related to stock prices are performed. For stock prices, the rate is not used in this paper as mentioned in the previous section. The results are shown in Table 1. Stock is Nikkei225 (Japanese representative stock price index; Nikkei is the newspaper company's name), call is the Japanese call rate, FF is FF rate in the United States, and exchange is the Japanese yen per U.S. dollar. All of the data are daily, and the sample period is from 2000 to 2018. Data are from Nikkei Telecom (database).

Table 1: Unit Root Tests of Each Variable

	T-Statistic	Probability
Stock	-1.520	0.523
Stock-stock(-1)	-69.497	0.000
Call	-1.693	0.434
Call-call(-1)	-36.683	0.000
FF	-1.903	0.330
FF-FF(-1)	-20.057	0.000
Exchange	-1.623	0.470
Exchange-exchange(-1)	-70.229	0.000
VI	-5.818	0.000
HV	-6.014	0.000

The one day change of each variable (level) is statistically significant, so they are used for estimations. For VI and HV, the days' ones are used instead of the change.

4.2   Regression Analyses
Regression analyses are performed. The estimated equation is Equation (1).

$$stock - stock\ (-1) = a_1VI + a_2HV + b_1exchange + b_2call + b_3FF \qquad (1)$$

This study also invokes the Generalized Method of Moments (GMM) along with Ordinary Least Squares (OLS). GMM is employed to solve the simultaneity problems linked with endogeneity that reveals the assessment of the direction of causality existence between variables. Lagged explanatory variables are used as instrumental variables in Equation (1).

The sample period is divided into before and after the inception of Abenomics. The former is from 2000 to 2012, and the latter is from 2013 to 2018. The results are shown in Table 2 (OLS) and Table 3 (GMM).

Table 2: Regression Results: OLS.

	Full-sample Period	Before Abenomics	After Abenomics
C	4796.655*** (10.656)	11521.28*** (62.813)	-4530.970*** (-12.859)
VI	-232.755*** (-19.744)	-67.492*** (-13.922)	-73.729*** (-9.738)
HV	59.400*** (6.126)	13.692*** (3.346)	-12.621** (-2.547)
Exchange	124.054*** (28.732)	-12.584*** (-6.730)	209.191*** (71.132)
Call	610.386 (1.588)	3410.464*** (23.388)	-4060.729*** (-6.572)
FF	48.797 (1.490)	1202.436*** (80.769)	2638.826*** (44.906)
Adj. R2	0.337	0.843	0.925
F-statistic	461.153	3403.105	3510.576
Probability	0.000	0.000	0.000
J-statistic			
Probability			
D.W.	0.010	0.028	0.044

Note. *** denotes significant at 1%, ** denotes at 5%, and * denotes at 10%.

Table 3: Regression Results: GMM.

	Full-sample period	Before Abenomics	After Abenomics
C	-119.901 (-0.092)	-80.469 (-0.438)	-4907.861*** (-5.400)
VI	-241.984*** (-7.216)	5.291 (0.651)	-50.476*** (-2.746)
HV	86.117*** (3.233)	2.363 (0.475)	-21.684** (-2.067)
Exchange	168.216*** (13.285)	-56.156 (-0.124)	208.293*** (28.384)
Call	4051.875*** (4.763)	2428.905 (0.387)	-2434.824* (-1.839)
FF	-213.888*** (-2.429)	3480.193 (0.421)	2670.389*** (14.294)
Adj.R2	0.307	0.788	0.728
F-statistic			
Probability			
J-statistic	171.944	0.066	51.049
Probability	0.000	0.796	0.000
D.W.	0.011	1.966	0.043

Note. *** denotes significant at 1%, ** denotes at 5%, and * denotes at 10%.

The results show that interest rates have influenced the Japanese stock prices after Abenomics. However, before Abenomics, Japanese interest rates had no impact on stock prices. Interest rates stayed at zero for both periods, but there are the predicted impacts on stock prices after Abenomics. The coefficients for exchange rates are negative before Abenomics, but they are not significant. On the other hand, they are positive and significant after Abenomics. It has been said that the Japanese economy is export-oriented. If the effect were strong, the coefficients would be positive and significant since depreciation of the domestic currency usually promotes exports and leads to increasing stock prices in such an economy as explained before. The results of this analysis show similarly after Abenomics as expected.

For the two volatility indexes, the results are expected. The coefficients of VI are negative both for the periods of before Abenomics and after Abenomics. As mentioned in section 3, this study hypothesized that the rising of VI promotes short sell and re-purchase of stocks in the future. Also, markets consider risk aversion, and the coefficients of HV before Abenomics were positive and negative after the Abenomics period. Before Abenomics, markets seemed to be bearish, and they became bullish after Abenomics. People expect recent Japanese policies to be effective for stock prices.

5. Conclusion

This study performed an empirical examination of the relationship between the Japanese stock prices and macroeconomic variables and between the Japanese stock prices and the two volatility indexes. For the two volatility indexes, the results are clear as expected. The most interesting point is that markets seem to change from bear to bull after introducing Abenomics, so they become positive for stock prices. In the Abenomics period, interest rates and exchange rates have expected effects on stock prices. Negative interest rates cause stock prices to rise, and depreciation of the yen promotes stock price rising as well. However, the evaluation of Abenomics is a different topic to explore. Whether or not the policies have been successful should be analyzed from other points of view [23]. There is definitely space for further analyses.

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