The Impact of the Fed's Rate Hike on the Japanese Gaming Company - Square Enix

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Abstract. The Fed's rate hike affects global stock markets in the short run. The volatility of Square Enix's earnings during the window period is analyzed by examining the net effect of Fed rate hikes on the stock price of Square Enix, a Japanese listed company, through VAR and GARCH model. The results show that the net capital outflow dominates the current period when the dollar appreciates relative to the yen in period t=0; Square Enix is the beneficiary of the current round of successive interest rate hikes under the change in cumulative effect. In addition, the impulse response shows that the change of return is basically in line with the "J-curve" effect. The capital outflow effect dominates in the first few periods of the exchange rate increase, and the export effect dominates over time. The coefficients of the logarithmic exchange rate and its lagged term show that the increase in the exchange rate has a significant effect on Square Enix volatility, and the effect is lagged. From the full model, the magnitude of the negative effect is smaller than the positive effect, and therefore, the exchange rate increase has a significant positive effect on the volatility of Square Enix returns. The study argues that Japan should maintain macro policy sustainability, avoid large fiscal deficits, and set aside sufficient policy space to address internal and external risk challenges.

Keywords: The Fed's Rate Hike; Stock Market Changes; Square Enix; GARCH.

1. Introduction

The Federal Reserve interest rate increase is a decision by the Federal Reserve System Board following an interest rate meeting in Washington, D.C. to adjust monetary policy by raising the federal funds rate.

The Fed announced on March 16, 2022 local time, that it will raise its target interval for the federal funds rate from 25 basis points to 0.25%-0.5%. This is the Fed's first rate hike since December 2018. The economic forecasts released at the meeting indicate that the Fed is likely to raise rates at the next six meetings this year.

On the afternoon of May 4, 2022 local time, to reduce the high rate of inflation in the United States, the Fed decided through its meeting to increase the U.S. federal funds rate by 0.5 percent (i.e., a 50 basis point increase, or a two-yard hike). FF interest rate increased from 0.75% to 1% after rate hike. This is the first time in 22 years that the Federal Reserve has raised interest rates by 0.5%.

On June 15, 2022, the U.S. Federal Reserve announced a 75 basis point increase to raise the target range for the federal funds rate to 1.5% and 1.75%. This is the Fed's largest interest rate increase since 1994, reflecting the urgency of controlling inflation [1].

As the world's most influential central bank, the Fed's interest rate policy adjustments have far-reaching effects on the world, especially on global financial markets, which are prone to become volatile under the Fed's interest rate policy adjustments. In short, rising interest rates are tight monetary policy, and the Federal Reserve is responding to the current economy by raising interest rates. a general increase in interest rates will raise interest rates at the banks and thereby reduce the amount of cash and raise the U.S. dollar. In addition, higher interest rates and a higher dollar exchange rate will affect the economy, for example, if the dollar appreciates, gold prices will fall and people will prefer to hold the U.S. dollar; in other countries, for example, currency devaluations will occur [2].

So, what are the implications of increasing U.S. reserves for the Japanese stock market? The impact, mainly in the following aspects.

On the one hand, it is that it may cause foreign capital outflow from the Japanese stock market. After foreign investors can invest directly in the Japanese stock market, the share of foreign capital in the Japanese stock market has increased significantly.

However, the fact that foreign capital can invest directly in the Japanese stock market is a double-edged sword for the Japanese stock market, as the inflow of foreign capital can fuel the rise of stock prices, and once the outflow also accelerates the fall of stock prices. Even the inflow and outflow of foreign capital have become the weather vane for the rise and fall of stock prices.

The Fed's interest rate hike could increase the willingness of foreign capital to flow out of the Japanese stock market. Because it means that the risk-free interest rate in the United States rises, this will attract the global free flow of profit-seeking capital to the United States, which may include foreign capital in the Japanese stock market.

In addition, a Fed rate hike would also cause the dollar to appreciate and the yen to depreciate against the dollar, which could also cause foreign investors to sell their stocks to increase their holdings of dollar-denominated assets [3].

On the other hand, it is the impact of investor confidence in the stock market. When the Fed raises interest rates, the U.S. stock market is likely to fall, and when the U.S. stock market falls, other major stock markets around the world are also likely to fall. When the world's major stock markets are down, domestic investors' sentiment is bound to be affected and it's hard to stay optimistic about the market. At the same time, the increase in interest rates in the United States is a tight monetary policy, which will inevitably lead to lower consumption and higher savings. This is also a negative factor.

However, at the same time, companies listed in Japan have their financial indicators and financial reports, etc. calculated in Japanese yen. In addition, as a multinational company with global operations, the appreciation of the dollar means that Japanese internationally listed companies have higher income from foreign countries, which is expressed as an export effect [4].

In summary, it can be found that the net effect of the Fed's interest rate increase on Square Enix cannot be derived from the theoretical analysis.

In order to study the above issues, the GARCH model can quantify the impact of the Fed's interest rate hike on the stock price of the international listed company Square Enix by its closing price change, studied the impact of the exchange rate change on the volatility of Square Enix's earnings, and then proposed relevant countermeasures and suggestions, taking Square Enix, an international company listed in Japan, as an example.

The remaining parts are built as follows: Part 2 is research design, including data sources, unit root test and model specification; Part 3 is Empirical Result which includes VAR model result, impulse response graph, ARMA order selection, ARMA-GARCHX model result. Then, the part 4 and 5 are discussion and conclusion respectively.

2. Research Design

2.1 Data Source

The price data in this study includes the opening and closing prices of Square Enix and the USD-JPY exchange rate from June 21 to September 22. The daily data above are sourced from the Investing website [5].

2.2 Unit Root Test

Unit root test (process) is used to check if the time series is correct.Most time series have been quantitatively analyzed and found to be stable. Therefore, before starting a study, one should check the stability of the data. If the sequences are unstable, possible ways to improve the results should be found. Unit root tests usually assume that the time series x_t can be written as:

$$x_t = c_t + \beta x_{t-1} + \sum_{i=1}^{p-1} \phi_t \Delta x_{t-1} + \varepsilon_i \quad (1)$$

The null hypothesis of the test states that the coefficient $\beta = 1$ indicates that the series has a unit root and is not stationary, while the alternative hypothesis $\beta < 1$ states that the test series is stationary. Table 1 shows the test results for the raw data and the processed sequence.

Table 1. ADF test

Variables	t-statistic	p-value
	Price	
Square Enix	-2.469	0.3437
Exchange rate	-2.031	0.5846
	Yield	
Square Enix	-11.839	0.0000***
Exchange rate	-12.430	0.0000***

Note：the level of significance of 1%, 5%, and 10% is showed by ***, **, and *, respectively.

The results show that all the logarithmic series of Square Enix stock prices were stable within the 95% confidence interval and that the stable conditions for the logarithmic growth of Square Enix stock prices were reliable within more than 99% of the confidence interval. based on these results, the following model can be constructed using these smooth series.

2.3 VAR Model Specification

2.3.1 Build A VAR Model

Vector Autoregressive Models (VARs) were first formally introduced by Sims in the 1980s [6]. It is a classic and fairly powerful statistical model for studying the relationships among multiple time series that vary over time; instead of creating a model for each variable assuming that each variable is affected by the other variables in the group, such as the ARMAX model, the VAR model puts these variables into a system and uses this multivariate time series to It creates an overall forecast.For example, a VAR model that considers only one lagged term (p=1) for two variables (x1, x2) would produce the following system:

$$\begin{cases} x_{1,t} = c_{11}x_{1,t-1} + c_{12}x_{2,t-1} + \varepsilon_{x_1^t} \\ x_{2,t} = c_{21}x_{1,t-1} + c_{22}x_{2,t-1} + \varepsilon_{x_2^t} \end{cases} \quad (2)$$

In this case with two variables (stock price, exchange rates), a Var(p) model can be written as:

$$y_t = \Gamma_0 + \Gamma_1 y_{t-1} + \cdots + \Gamma_p y_{t-p} + \varepsilon_t \quad (3)$$

In (3), y_t refers to the two response variables in this system. $\Gamma_1, \Gamma_2 \ldots \Gamma_p$ are the coefficient matrix to correspond terms. ε_p is the matrix from the error term in period t. In this paper, Square Enix's stock closing price and the USD-JPY exchange rate will be variables in the Var model.

2.3.2 Impulse Response Graph of the VAR Model

In this case, there are 3*11 estimates of the VAR, which is so many as to analyze, as for impulse response plots are a helpful tool to examine the interactions in the VAR system or between variables. Response plots create an exogenous pulse and observe the system's response to it with time passing. Typically, the effect of response is calculated as follows:

$$\psi_s = \frac{\partial y_{t+s}}{\partial \varepsilon_t} \quad (4)$$

The response effect, indicated by equation (4), is supposed to be the change of $y_{i,t+s}$,the value of variable i which is in the timestamp t+s, at the timestamp t when variable j increases by one unit in the disturbance term ε_{jt}. (4) can becomes the famous impulse response function (IRF), If it is described as a function of time interval s.

2.3.3 LR for VAR identification

In the modeling process, the VAR needs to determine:

(1) the number of variables (N) for which there is an interaction relationship.

(2) how many lagged variables are needed to explain clearly the endogenous variables for which there is an interaction relationship (k).

If k is too small, it will lead to autocorrelation problems of the error terms, which may result in excessive errors in the estimation of the model parameters.

If too large,a k leads to a reduction in the degrees of freedom of the model, which directly affects the validity of the model parameter estimates.

Here we use the LR rule to determine the maximum lag order k.

$$LR = -2(LogL_k - LogL_{k+1}), \text{ and } LR \sim \chi^2_{(N^2)} \quad (5)$$

When the LR statistic is less than the critical value, it is considered that the lag order of the VAR model is moderate. When the LR statistic is greater than the critical value, the lag order of the VAR model is considered to be not high enough, and it is necessary to continue adding more lagged variables as explanatory variables. When the sample size is not sufficiently large compared with the number of parameters being estimated, the finite sample distribution of LR and the asymptotic distribution of LR will have a large difference.

2.4 ARMA-GARCH Model Specification

Until Engel proposed the autoregressive conditional heteroscedasticity model (ARCH model) in 1982, most economists' work assumed that time-series variances are constant and do not change much and follow the laws of stochastic processes [7]. However, in actual market data, variance represents the risk of an asset, and since market risk cannot always be the same, it is natural for variance to change over time. The Arch model predicts future dispersion. In general, the Arch(p) model can be written as follows:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \cdots + \alpha_p \varepsilon_{t-p}^2 \quad (6)$$

where the σ_t is the forecast variance for period t. ε_t is the actual variance for period t. α_0 is a constant value.

In 1986, Bollerslev improved upon the ARCH model and introduced the ARCH model in the broadest sense (GARCH). He added elements of GARCH to the original ARCH model, making it the most basic and most powerful model for time series analysis [8], which is logically similar to converting an AR model to an ARMA model and reducing the number of estimated coefficients in the ARCH model. In general, the GARCH (p, q) model can be written as follows:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \cdots + \alpha_p \varepsilon_{t-p}^2 + \beta_1 \sigma_{t-1}^2 + \cdots + \beta_p \sigma_{t-q}^2 \quad (7)$$

Since market returns are directly related to risk, risk remains the most important attribute of a market or sector. For risk, the ARMA-GARCH model was developed to analyze AAL's price volatility; the ARMA portion also analyzes value, but one should focus on the Garch component to draw conclusions about market risk.

3. Empirical Results

3.1 VAR Model Results

In this paper, three stationary series - the log series of stock prices and the log series of newly identified increasing cases in the United States and the world - are fed into our vector autoregressive system. The results show that a VAR with 23 orders can be considered, as shown in Table 2.

After setting up the VAR model (23), this paper uses STATA's varstable tool to check the stable state of the eigenvalues after estimating the vector autoregressive parameters and visualize the results by drawing a unit circle. If all points displaying a feature are within the unit circle, the var estimate is stable. Figure 1 shows the results, indicating that the stability conditions for this var system are satisfied.

Table 2. VAR model identification

Lag	LL	LR	df	p
0	1751.66			
1	1752.57	1.8159	4	0.770
2	1753.56	1.9719	4	0.741
3	1755.34	3.5663	4	0.468
4	1757.05	3.4244	4	0.489
5	1758.2	2.3069	4	0.680
6	1759.82	3.2292	4	0.520
7	1762.67	5.7098	4	0.222
8	1765.43	5.5123	4	0.239
9	1768.9	6.9492	4	0.139
10	1769.46	1.1115	4	0.892
11	1771.86	4.7894	4	0.310
12	1772.27	.8295	4	0.934
13	1775.7	6.8651	4	0.143
14	1778.1	4.7937	4	0.309
15	1779.61	3.013	4	0.556
16	1781.87	4.5208	4	0.340
17	1785.62	7.498	4	0.112
18	1787.47	3.7105	4	0447
19	1791.81	8.6711	4	0.070
20	1792.9	2.1836	4	0.702
21	1795.46	5.1147	4	0.276
22	1798.7	6.4942	4	0.165
23	1800.36	3.3175	4	0.506
24	1800.86	1.0054	4	0.909

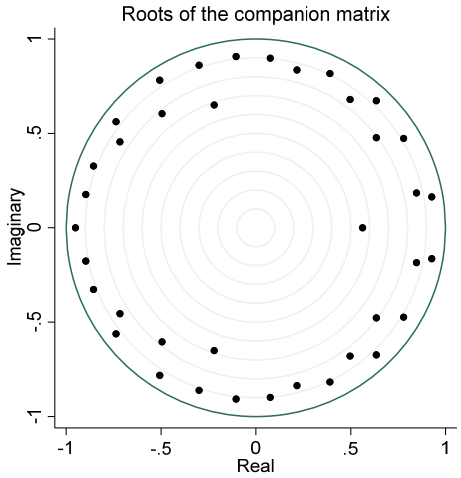

Figure 1. VAR stability
Photo credit: Original

3.2 Impulse Response Graph

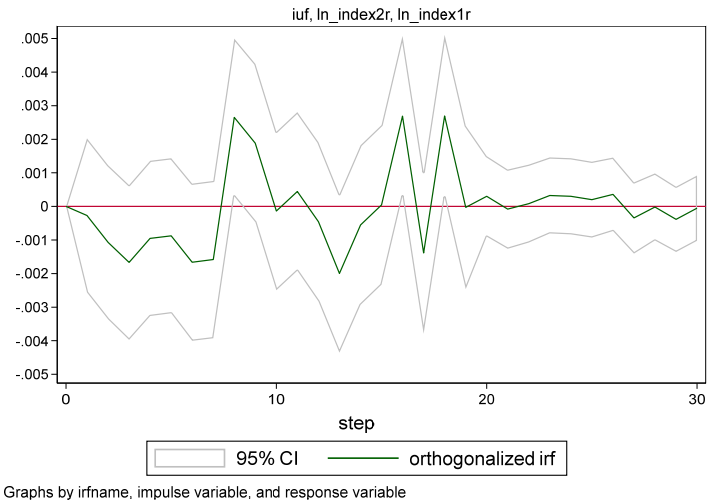

Figure 2. Impulse and response
Photo credit: Original

From the estimated results of the impulse responses (Figure 2), the effect of a one-unit exchange rate shock in period t=0 on Square Enix is negative in all the next seven periods, with the largest negative effect in that period being slightly less than 0.2%. This result suggests that net capital outflows dominate when the exchange rate change in the current period first occurs. Subsequently, with the exception of a small number of periods, Square Enix returns begin to turn positive, with a maximum positive effect of slightly less than 0.3%.

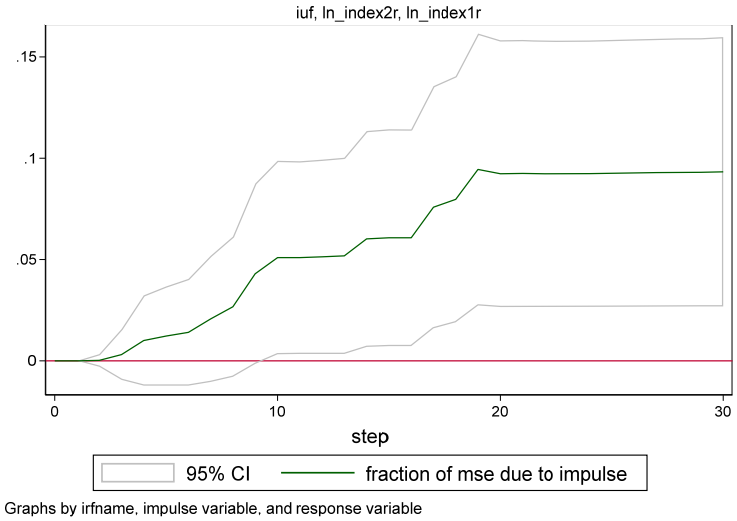

Figure 3. Cumulative response
Photo credit: Original

However, it is difficult to judge the net effect of exchange rate changes on Square Enix's impact only from the estimated results of the impulse response function. Accordingly, this paper further calculates the cumulative effect function (Figure 3), which shows that the cumulative effect of the current exchange rate shock on Square Enix in the next 30 periods is slightly less than 10%, which indicates that Square Enix is the beneficiary of the current round of successive interest rate increases.

In addition, the impulse response image basically shows that the change in returns is basically in line with the "J-curve" effect. The capital outflow effect dominates in the first few periods of the exchange rate increase, and the export effect dominates over time.

3.3 ARMA Order Selection

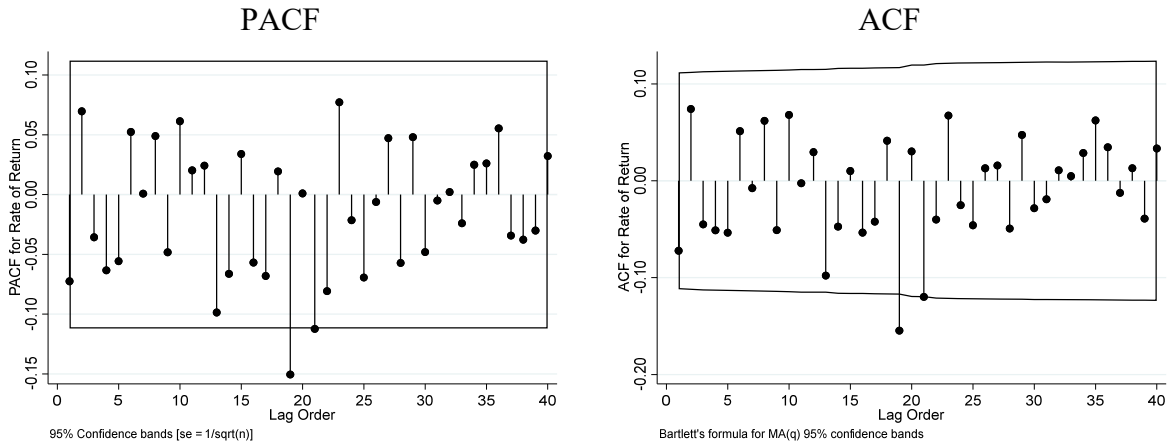

Figure 4. PACF and ACF

Photo credit: Original

This paper needs to order the log returns of the first semiconductor and present the results in the figure above. From the fixed order result of the two images in the row in Figure 4, the first part beyond the x-axis is 19, so AR(P) is of order 19, MA(q) is also of order 19. i.e., the value of p and q is 19.

3.4 ARMA-GARCHX Model Results

From the time series plot (Figure 5), it can be found that there is a relatively significant aggregation of Square Enix returns, but whether this effect is significant requires further empirical testing.

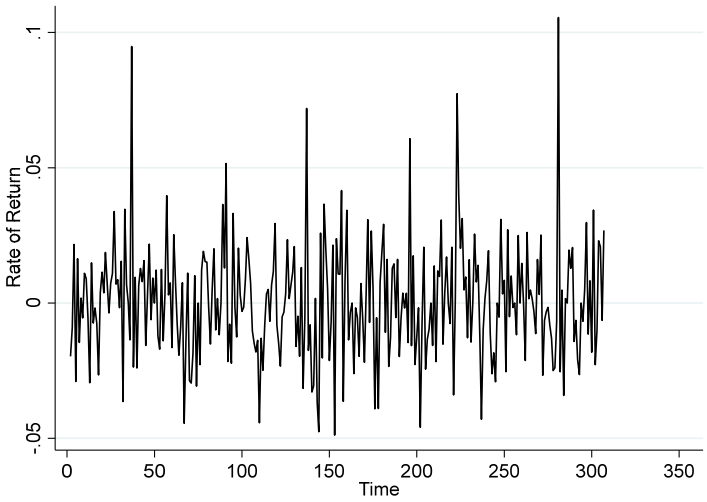

Figure 5. Yield trend

Photo credit: Original

From the ARMA-GARCH estimation results in Table 3, both the ARCH and GARCH terms in column (1) are insignificant and do not meet the modeling requirements of the GARCH model.

The ARCH terms in columns (2) and (3) are not significant, but the GARCH terms are significant, so this paper focuses on the estimation results of the latter two columns.

From the coefficients of the log returns of the exchange rate and its lagged term, it is clear that an increase in the exchange rate has a significant effect on Square Enix volatility, and this effect has a lag.

From the full model in column (3), the magnitude of the negative effect is smaller than the positive effect, therefore, the exchange rate increase has a significant positive effect on the volatility of Square Enix returns.

Table 3. ARMA-GARCH estimation results

	(1)		(2)		(3)	
	Coef.	p>|Z|	Coef.	p>|Z|	Coef.	p>|Z|
Exchange rate						
L0	37.6696	0.081	71.2980	0.002	27.8094	0.001
L1			-79.4820	0.000	11.4109	0.236
L2					-18.1916	0.067
GARCH (1, 1)						
ARCH, L1	0.0005	0.992	0.0164	0.777	0.0409	0.342
GARCH, L1	0.0024	0.996	0.5085	0.004	-0.6238	0.002
Constant	-7.7895	0.000	-8.6389	0.000	-7.2626	0.000

4. Discussion

Compared to the literature on Chinese internationally listed companies in the context of Fed rate hikes, it can be found that both Chinese and Japanese companies show a negative effect when capital outflows are considered [9]. However, when the combined exchange rate changes are considered, Chinese companies still have a negative effect, while Square Enix, the Japanese company studied in this paper, exhibits a positive effect. It can be seen that the exchange rate against the U.S. dollar plays an important role in the study of firm earnings in the context of the Fed's interest rate hike.

To cope with this impact, the government needs to maintain macro policy sustainability, not to significantly increase the fiscal deficit and over-issuance of money, and set aside sufficient policy space to deal with internal and external risk challenges. Next, macro policy should increase regulation to solidly stabilize the economy. Monetary policy should adhere to self, fiscal policy should enhance the effectiveness, continue to expand effective investment, boost terminal consumption and boost the confidence of market players through tax cuts, direct funding, special bonds and other policy measures.

The variables used in this paper are stock prices and exchange rates, which differs from another study on a similar issue, which uses commodity trading as a variable [10]. To some extent, the study lacks representativeness, and future studies can be improved in this direction to obtain more accurate conclusions.

5. Conclusion

The Federal Reserve's repeated and substantial interest rate hikes in 2022 to control domestic inflation have caused the dollar to appreciate and the yen to depreciate in the short term.

The appreciation of the dollar relative to the yen may lead to: higher (lower) stock prices or yields in the U.S. (Japanese) stock market; higher income from foreign countries for Square Enix, which is expressed as an export effect; lower consumption and higher savings.

In summary, it can be found that the net effect of the Fed's interest rate increase on Square Enix cannot be derived from the theoretical analysis. To this end, this paper examines the net impact of the Fed's rate hike on the stock price of Square Enix, a publicly traded Japanese company, through VAR and GARCH models, and analyzes Square Enix's earnings volatility during the window period.

The results show that the net capital outflow dominates the current period when the dollar appreciates relative to the yen in period t=0; Square Enix is the beneficiary of the current round of successive interest rate hikes under the change in cumulative effect. In addition, the impulse response shows that the change of return is basically in line with the "J-curve" effect. The capital outflow effect dominates in the first few periods of the exchange rate increase, and the export effect dominates over time. The coefficients of the logarithmic exchange rate and its lagged term show that the increase in the exchange rate has a significant effect on Square Enix volatility, and the effect is lagged. From the

full model, the magnitude of the negative effect is smaller than the positive effect, and therefore, the exchange rate increase has a significant positive effect on the volatility of Square Enix returns.

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