

# An Analysis of Relationship between the US and the Japanese Stock Market Over Time

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## ABSTRACT

*This study attempts to investigate and analyze whether there exists an integrating relationship between the stock markets of US and Japan. The nature and strength of the relationship and how it has changed over time is analyzed to study the linear paradigm that is often suggested. Theoretically, there is no reason to believe that the economic systems are intrinsically linear, however, the results show a surprisingly strong relationship over time.*

**Key Terms:** Return, Risk, Diversification, Japanese Stock Market, Contagion, Correlations

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**INTRODUCTION**

For the last few decades a considerable amount of research has been done to investigate long-term relationships between stock markets of US with many other international markets (Taylor and Tonks, 1989; Chowdhury, 1994; Kanas 1999; Chang and Caudill, 2006; Chang, Mo and Liu, 2009). Empirically, many studies show that financial time series such as stock prices exhibit non-linear dependencies (Barkoulas and Travlos, 1998). Since Japan has been a major trading partner of the United States since 1970s, spanning over a period of almost five decades, it is interesting to see the relationship between the stock markets of US and Japan. Japan continues to be a major trade partner of the United States even though the trade relationship between the two weakened, since the 1990s when China emerged as a leading player.

The purpose of this study is to investigate and analyze the relationship between US and Japanese stock markets over time as the trading relationship between these two countries changed over time. Specifically, interdependency and/or integrating tendencies between the stock markets is analyzed to reflect on the nature and strength of the relationship.

**BACKGROUND LITERATURE**

Relationships between the returns of national stock markets have been an important area of interest for business area academics and investors for over 30 years (Durand, Kee and Watson, 2001). Correlating international markets generally assumes that the observations are independent; however, this assumption does not hold based on a growing body of evidence presented in the literature. US stock market returns seem to influence the returns of other markets (Eun and Shim, 1989; Phylaktis, 1997; Ghosh, Saidi and Johnson, 1999; Arshanpalli and Kulkarni, 2001; Rafiqul et al., 2016). Ghosh et al. (1999) show that Japan is found to influence non-Japanese capital markets.

Previous research in the area of market interrelationships shows that markets do move together. For example, Eun and Shim (1989) investigated the international transmission mechanism of stock market movements by estimating a vector autoregression for nine markets using daily data from December 31st, 1979 to December 20th, 1985 and found that variations in the US are rapidly transmitted to other markets in a clearly recognizable fashion. Their research shows that the US market is the most influential and Japanese stock market acts like a follower in international stock markets.

To further study the expansive role of US and Japanese stock markets in influencing other international markets, Durand, Kee and Watson (2001) utilized the daily stock price indices of seven difference markets of Asia and Pacific Rim countries such as Australia, Hong Kong, Korea, Malaysia, Singapore, Taiwan and Thailand. Their results suggest that even though less developed markets are prone to take their lead from the US, the effect of the US market on Australian and Singapore markets was the strongest. The Japanese market also had a statistically significant impact on Hong Kong, Korea, Malaysia and Taiwan markets.

Ishii (2008) specifically used the time series of US and Japanese equity market indexes and found that the contemporaneous

transmission from the US to Japanese markets is significant, but not from the Japanese to the US stock market.

This study uses the monthly data starting from January 1, 1988 to September 1, 2019 to analyze the nature and strength of US-Japanese stock market and how the relationship between these two markets has changed.



**ODEL**

Monthly data were obtained from Yahoo Finance for Nikkei, S&P 500 and Russell 2000 Index spanning time period from January 1, 1988 to September 1, 2019. Following model

was used to compute monthly return mean, variance, skewness and kurtosis:

Monthly Return  $r_t = (P_t - P_{t-1}) / P_{t-1}$

Monthly Mean  $\alpha = (r_1 + r_2 + \dots + r_N) / N$

Monthly Variance  $\sigma^2 = \sum (r_i - \alpha)^2 / (n-1)$

Monthly Skewness  $sk^3 = n / (n-1)(n-2) \times \sum (r_i - \alpha)^3 / \sigma^3$

Monthly Kurtosis

$k = n(n+1) / (n-1)(n-2)(n-3) \sum [(r_i - \alpha) / \sigma]^4 - 3(n-1)^2 / (n-2)(n-3)$

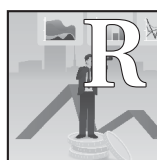
The relationship between Nikkei Index and S&P 500 and Russell 2000 Index were identified using the following correlation model:

$$Correl(X, Y) = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sqrt{\sum (x - \bar{x})^2 \sum (y - \bar{y})^2}}$$

Regression Model: Returns of Nikkei and S&P 500 Index and Nikkei and Russell 2000 were regressed with Nikkei Index return as the dependent variable.

$r_{nikkei} = a + b r_{SP500}$

$r_{nikkei} = a + b r_{Russell}$



**RESULTS**

Table 1 provides descriptive statistics for Nikkei, S&P 500 and Russell 2000 Index for overall data from January 1, 1988 to September 1, 2019 and two sub-periods. Sub-Period 1 covers data from January 1, 1988 to December 31, 2003 and Sub-period 2 covers data from January 1, 2004 to September 1, 2019.

*Table 1 : Descriptive Statistics for Nikkei, S&P 500 and Russell 2000 Index*

	Mean	Standard deviation	Skewness	Kurtosis
<b>Nikkei</b>				
Overall Period	-0.027	6.013	-0.573	1.225
Sub-period 1	-0.418	6.505	-0.271	0.354
Sub-Period 2	0.368	5.461	-0.996	2.818
<b>S &amp; P 500</b>				
Overall Period	0.661	5.310	-0.764	1.737
Sub-period 1	0.781	5.380	-0.749	1.541
Sub-Period 2	0.539	5.249	-0.790	1.990
<b>Russell 2000</b>				
Overall Period	0.645	4.098	-0.782	1.777
Sub-period 1	0.767	4.232	-0.599	0.891
Sub-Period 2	0.521	3.966	-1.025	2.957

Overall Period covers data from January 1, 1988 to September 1, 2019.

From Table 1 it is evident that for the overall Nikkei 225 Index is more volatile than S&P 500 and Russell 2000 Index. Nikkei 225 Index is a price-weighted stock index in Japanese Yen for the Tokyo Stock Exchange consisting of companies from Foods, automotive, textiles and apparel, paper and pulp, banking, steel, insurance and other financial services, real estate, electrical machinery, warehousing, communication, electrical power, gas, shipbuilding and other services. This index has been very volatile as it stood at 38,957 on December 29, 1989. The current Index value as of September 19, 2019 is 22,044 which is much lower than its peak in 1989. As of March 10, 2009, this index reached the bottom at 7,055 about 82% below its peak. Obviously, this index has average-values that are negative for the overall period (January 1, 1988 to September 1, 2019) and sub-period 1 which covers time period from January 1, 1988 to December 31, 2003. The Index however became positive for the second sub-period spanning from January 1, 2004 to September 1, 2019. This index is negatively skewed and kurtotic for the second sub-period. However, stocks were less kurtotic for the first sub-period.

S&P 500 Index is a stock market index of 500 large US companies and has generated an average return of about 9.8 percent since its inception in 1926. As expected, this index has witnessed volatility over different time periods. For the overall period, the mean monthly return is 0.661. Unlike Nikkei Index, the returns were higher for the first sub-period when compared to the second sub-period. But, volatility for the first sub-period is slightly above the second sub-period. For all periods, S&P 500 displayed negative skewness. Hence, there is a greater tendency for the stocks to decline than to go up. The excess kurtosis is higher for the second period implying tendency for the stocks to either generate high positive or negative returns. On the other hand, Russell 2000 Index which is a benchmark for small capitalization US small stock returns is maintained by FTSE Russell, a subsidiary of London stock Exchange. The weighted average market capitalization of the companies in this index stood at \$2.43 billion. Nikkei225 index has displayed elevated negative skewness and excess kurtosis for the second sub-period. Its average values are significantly higher for the first sub-period when compared against second sub-period. Surprisingly its monthly volatility is much less than both Nikkei and S&P 500 index.

Correlation analysis is shown in Table 2 between Nikkei and the two US indices S&P 500 and Russell 2000. As expected, the correlation is very high (0.83) between S&P 500 and Russell 2000. With the Japanese market the correlation between S&P 500 stood at 0.409 for the first sub-period but it became much higher at 0.656 for the second sub-period implying that Japanese stock market became more highly correlated with the US equity market. Similar results can be seen if we examine correlation between Nikkei and Russell 2000 Index.

**Table 2 : Correlation Analysis between Nikkei, S&P 500 and Russell 2000 Index**

	Nikkei	S&P 500	Russell 2000
<b>Overall Period</b>			
Nikkei		0.515	0.535
S&P 500	0.515		0.810
Russell 2000	0.55	0.810	
<b>Sub-Period 1</b>			
Nikkei		0.409	0.418
S&P 500	0.409		0.738
Russell 2000	0.418	0.738	
<b>Sub-Period 2</b>			
Nikkei		0.656	0.696
S&P 500	0.656		0.889
Russell 2000	0.696	0.889	

Overall Period covers data from January 1, 1988 to September 1, 2019. Sub-Period 1 covers data from January 1, 1988 to December 31, 2003 and Sub-period 2 covers data from January 1, 2004 to September 1, 2019.

From Table 3 we can see the bivariate regression results with Nikkei Index as the dependent variable. Although the Nikkei Index comprises 225 biggest Japanese companies, however, out of the two sub-periods the Nikkei Index displays a stronger relationship with Russell 2000 Index with R-square that stood at 47%. Even with S&P 500 Index, the relationship is stronger as the R-square went up to 30% versus 17% in the previous period.

**Table 3 : Regression Analysis between Nikkei as Dependent and S&P 500 and Russell 2000 Indices as Independent Variables**

S&P 500	Coefficient	t-stat	Russell 2000	Coefficient	t-stat
<b>Overall Period</b>					
Constant	0.673	2.88	Constant	0.880	3.15
Nikkei	0.455	11.69	Nikkei	0.272	6.32
F-stat		136.72	F-Stat		39.90
R-Square		0.27	R-Square		0.29
<b>Sub-Period 1</b>					
Constant	0.922	2.59	Constant	0.654	3.68
Nikkei	0.339	6.16	Nikkei	0.365	12.32
F-stat		38.05	F-Stat		39.90
R-Square		0.17	R-Square		0.17
<b>Sub-Period 2</b>					
Constant	0.203	0.47	Constant	0.495	1.68
Nikkei	0.519	5.61	Nikkei	0.499	7.86
F-stat		31.48	F-Stat		61.80
R-Square		0.31	R-Square		0.47

Overall Period covers data from January 1, 1988 to September 1, 2019. Sub-Period 1 covers data from January 1, 1988 to December 31, 2003 and Sub-period 2 covers data from January 1, 2004 to September 1, 2019



## CONCLUSION

The relationship between the US and the Japanese markets has been analyzed over two time periods. The Japanese market during the two sub-periods starting from January 1, 1988 to December 31, 2013 and January 1, 2004 to September 1,

2019 has witnessed major changes due to aging of population and emergence of China in the second sub-period. As a result, although Nikkei Index has not regained its past glory, but the index has shown improved performance in the recent time period. This is primarily due to favorable Japanese monetary and fiscal policy. This is one of the explanations why the Nikkei Index has become more correlated with the US market in the second sub-period. In the first sub-period however, the Japanese market was less correlated with the US markets. This implies that the Japanese monetary and fiscal policies have had a positive effect on their stock market leading to higher integration with US stock market.

## REFERENCES

- i. Arshanpalli, B and Kulkarni, S. "Interrelationship between Indian and US stock markets," *Jornal of Management Research*, Vol. 1, No. 3, pp 141-148.
- ii. Barkoulas, J and Travlos, N. (1998), "Chaos in an Emerging Capital Markets? The Case of the Athens Stock Exchanger," *Applied Financial Economics*, Vol. 8, pp. 231-243.
- iii. Chang T and S.B. Caudill (2006), "A Note on the long-run benefits from international equity diversification for a Taiwan Investor Diversifying in the US Equity Market", *International Review of Financial Analysis*, Vol. 15, pp.57-67.
- iv. Chang, Tsangyao, Chien-wen Mo and Wen-Chi Liu (2009), "International Equity Diversification between Japan and Its Major Trading Partners", *Applied Economics Letters*, Vol. 16, pp.1433-1437.
- v. Chowhury, A.R. (1994), "Stock Market Interdependencies: Evidence from the Asian NIEs," *Journal of Macroeconomics*, Vol. 16, 629-651.
- vi. Durand, Robert, Koh Sze Kee and Iain Watson (2001), "Who Moved Asian-Pacific Stock Markets? A Further Consideration of the Impact of the US and Japan", *Australian Journal of Management*, Vol. 26, No. 2, December 2001, pp.125-145.
- vii. Eun C and S. Shim (1989), "International Transmission of Stock Market Movements", *Journal of Financial and Quantitative Analysis*, Vol. 24, pp.241-256.
- viii. Ghosh A, R Saidi and KJ Johnson (1999), "How Moves the Asia-Pacific Stock Markets –US or Japan? Empirical Evidence based on the Theory of Cointegration" *The Financial Review*, Vol. 34, pp. 159-69.
- ix. Ishii Youta (2008), "International Transmissions in US-Japanese Stock Markets", *Applied Financial Economics*, Vol. 18, 1193-1200.
- x. Kanas, A. (1999), "A note on the long-run benefits from the International Equity Diversification for the UK Investor Diversifying in the US Equity Market", *Applied Economics Letters*, Vol. 6, 47-53.
- xi. Phylaktis, K (1997), "Capital Markets Integration in the Pacific-based Region: An Analysis of Real Interest Rate Linkage," *Pacific-Based Financial Journal*, Vol. 5, pp. 195-213.
- xii. Rafiq, Bhuyan et al., "Information transmission and dynamics of stock price movements: An empirical analysis of BRICS and US stock markets", *International Review of Economic & Finance*, Vol. 46, pp. 180-195.
- xiii. Taylor, M. P. and I. Tonks (1989), "The Internationalization of Stock Markets and the Abolition of UK Exchange Control", *Review of Economics and Statistics*, Vol. 71, pp.332-336.