

# *A Test for CAPM in Japan and US*

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**Abstract.** Asset pricing model is one of the most fundamental studies in the field of finance. The simple CAPM model introduced in 1960s aims to relate the return of stocks and portfolios to the beta, which represents these assets' level of risk. It has covered a long distance, so the paper conducts a test on it based on the data of Japanese and US stock market to see whether it's still accurate. The data is from January 2020 to December 2022 and 72 cross-sectional regression equations was calculated. The results of the test indicate that the CAPM is not applicable in Japan but still precise in US. And it can help the investors and other financial researchers to have an overview about the stock market in these two countries and their market index. The paper also suggests that people who invest in financial markets should not only rely on the basic CAPM model but also take other factors into account.

**Keywords:** CAPM, asset pricing, US, Japan, stock market index

## 1. Introduction

The development of the capital asset pricing model is considered a crucial contribution to modern financial market studies. Built upon the groundwork laid by Harry's [1-2] earlier work on modern portfolio theory, the CAPM was established by Sharp [3], Lintner [4] and Black [5] as the theoretical basis to estimate the price of the financial assets with the help of the equilibrium model. The 1960s and 1970s witnessed widespread agreement on the model as the model itself is solid both theoretically and empirically. This model is later regarded as a huge success. But the papers by other researchers like Stattman [6], Basu [7] and various others have shown many inconsistencies. CAPM cannot explain some phenomenon like size effect, leverage, and value effect. The CAPM was challenged and questioned whether it can be a practical asset pricing model.

Even though there are voices about the disadvantages of CAPM, it is still one of the most important models of asset pricing. And now the paper will use the recent data of Japan and US stock market to evaluate the applicability of capital asset pricing model. Using rolling regression models, this essay tests the data from Japanese and US stock market by the standard CAPM model. Based on 3 years' data, the paper estimated 72 equations for Japan and US. For both Japan and US, the paper tests the linear pricing relationship resulted from the CAPM. The primary purpose for this research is to review the applicability of CAPM in Japan and also in US, because research in this field mainly focused on the western market.

There are six sections in this paper. The next section is the review of literature. The third section shows the sources of the data and describe why the paper chooses these data. In the next part the paper explains the methodology of the CAPM and how it is used to conduct our research. Outcomes

of the tests are stated in the fifth part. The final section of the study is the description of the summary and conclusion of this study.

## 2. Data

The data pertain to the Japanese capital market from January 2020 to December 2022. They are used to estimate the parameters and then to construct the security market line and their return. The linear model is created, and it can have a trend of the data from January 2020 to December 2022. The Japan capital market data refers to the Nikkei 300 that can be represented as the market portfolio. And based on the beta, it can create the security market line (SML) by using the fundamental stocks in the index. The paper collects the related data from Investing.com [8]. The precondition of the data is that the company must have a complete record for three years. Any missing information will cause the data of the company to be ignored. Finally, a set of 36 companies was select with complete data in 3 years. This set of companies are used to form the portfolio and test the model. Obtained from Bloomberg.com [9], the risk-free rate for Japan is JGB 2-year yield treasury bills rate. The data concerning the US is collected from the French Kenneth library online [10]. The equities are selected from S&P 500 to form the market portfolio, and its principal stocks are used to structure portfolios according to the beta. Only those companies selected for the study whose complete data for the three years is available. Similarly, another set of 36 companies was select with complete data in 3 years.

## 3. Methodology

The model CAPM is used to value equities or portfolios. It uses SML and SML's relationship with expected return and systematic risk (the beta) to estimate how the market must price the security related to its risk. The SML calculates the return-to-risk ratio for any security relative to the overall market. Thus, Hence, if we adjust the anticipated rate of return of a security by taking into account its beta coefficient, the ratio of reward to risk for that specific security is equivalent to the reward-to-risk ratio of the entire market, which can be written in:

$$\frac{E(R_i) - R_f}{\beta_i} = E(R_m) - R_f \quad (1)$$

And by rearranging the above equation and solving for  $E(R\{i\})$ , the capital asset pricing model (CAPM) can be obtained.

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f) \quad (2)$$

$E(R\{i\})$  is the expected return of the asset.

$R\{f\}$  is the risk-free rate of interest.

beta  $\{i\}$  (the beta) is the sensitivity of the expected excess asset returns to the expected excess market returns.

$E(R\{m\})$  is the expected return of the market.

$E(R\{m\}) - R\{f\}$  is the market premium.

$E(R\{i\}) - R\{f\}$  is the risk premium.

The paper use the data of the equities previously collected and form a linear regression model where the x-axis is beta, and the y-axis is the return of the equity in 3 years. And then, it is compared with the SML formed by the market premium and risk-free rate in the form of the second model the paper lists above. By comparing the two models, it can be decided whether the CAPM can prove the linear regression model, which shows the exact data of the equities. If the two models are close, it can be said that CAPM can explain most of the equities in the markets.

## 4. Empirical Results

In this section, the paper will evaluate the outcome of the data analysis of Japanese and US capital market index.

### 4.1. Japan

The empirical outcome of the CAPM test by evaluating the Japanese stock market data is shown in Table 1, Fig. 1 and Fig. 2. Based on the betas, the paper constructs the linear regression of the equities. A cross-sectional regression is constructed by regressing these betas on the three years return of the selected equities and the market premium previously obtained. And then the regression technique is used to run 36 cross-sectional regressions and the results can be obtained from January 2020 to December 2022. The CAPM indicates that in the cross-sectional regression, the intercept term should be zero. And the market risk premium, represented by the slope, should be positive and significant. In Fig. 2, the outcomes of 36 cross-sectional regressions are stated. In the total 36 regression intercepts, only four are not significantly different from zero, as predicted by CAPM. 12 are significant at 5%, and 20 are significant at 1% in all the significant intercept. The results undoubtedly indicated that the CAPM does not work in Japanese stock market. In addition, the market risk premium and the cross-sectional regression equation's regression coefficient are investigated. The regression coefficient that represent market risk premium is insignificant for eight regression equations. The cross-section regression coefficients are significant in all other regression equations. Yet it still differs from the CAPM theory as the signs of these coefficients are negative. Therefore, indicated by the outcomes of analyzing the 36 cross-sectional regression equations, it can be concluded that CAPM does not apply to the Japanese stock market.

Table 1: The performance of some companies in Nikkei 300 from January 2020 to December 2022.

Name	Beta	Returns (3 Years)
Acom Co Ltd	0.457	-14.17%
Aeon	0.294	34.33%
Aeon Financial Service Co Ltd	0.728	7.33%
Aeon Mall Co Ltd	0.421	41.85%
AGC	0.841	95.91%
Ajinomoto Co., Inc.	0.017	169.28%
Amada	1.17	58.48%
Amano Corp	0.407	19.53%
Asahi Group Holdings	0.73	49.97%
Asics Corp	1.46	320.58%
Astellas Pharma Inc.	0.512	27.30%
Avex Group Holdings	0.279	81.36%
Bandai Namco Holdings Inc	0.421	73.26%
Benesse Holdings	0.156	-12.63%
Biprogy	0.452	24.61%
Bridgestone Corp.	0.493	70.64%
Brother Industries Ltd	0.854	35.35%
Canon	0.451	37.62%
Canon Marketing Japan Inc	0.278	67.47%
Central Japan Railway Co.	0.324	0.00%
Chiba Bank	0.497	114.36%

Table 1: (continued).

Chubu Electric Power Co., Inc.	0.253	12.26%
Chudenko Corp	0.337	11.07%
Chugai Pharmaceutical	0.513	-5.60%
Citizen Holdings	0.686	155.10%
Comsys Holdings Corp.	0.479	7.10%
Concordia Financial Group	0.593	85.61%
Dai Nippon Printing	0.549	82.27%
Dai-ichi Life	0.687	132.85%
Daicel Corp	0.681	44.86%
Daiichi Sankyo	0.476	136.51%
Daikin Industries	0.945	94.82%
Daito Trust Construction	0.359	37.11%
Daiwa House Industry	0.516	30.95%
Daiwa Securities Group Inc.	0.649	58.74%
DeNA Co	0.511	55.99%

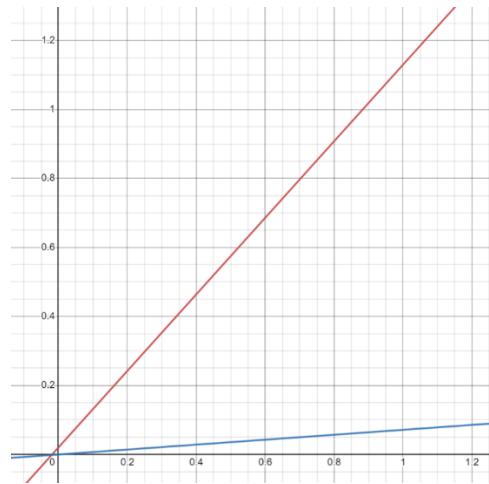


Figure 1: Comparison between regression lines.

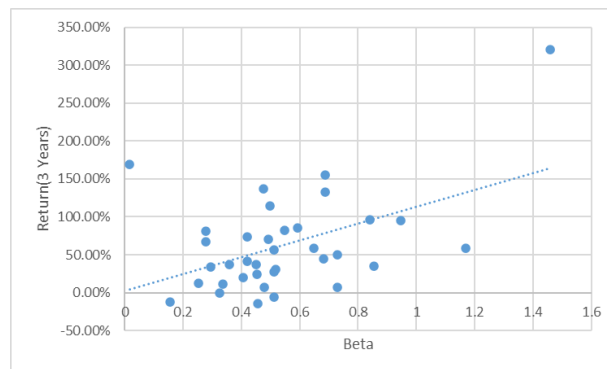


Figure 2: Regression line.

## 4.2. US

Similarly, the empirical outcome of the CAPM test by evaluating the US stock market data is shown in Table 2, Fig. 3 and Fig. 4. Based on the betas acquired, the paper constructs the linear regression of the equities. A cross-sectional regression is constructed by regressing these betas on the three years return of the selected equities and the market premium previously obtained. And then the regression technique is used to run 36 cross-sectional regressions and the results can be obtained from January 2020 to December 2022. In Fig. 3, the outcomes of 36 cross-sectional regressions are stated. In the total 36 regression intercepts, 28 are not significantly different from zero, as predicted by CAPM. Only six are significant at 5%, and two are significant at 1% in all the significant intercept. The outcomes can clearly prove that the CAPM fits better in the US stock markets. The paper again attempts to dig deeper into the model by studying the regression coefficient representing market risk premium. It is found that for 32 regression equations, the market risk premium is significant. It means that only four regression equations are not applicable to the CAPM for the US stock market, which is a small proportion of the data set. Furthermore, the market risk premium is positive for all these 32 equations. The paper concludes that the CAPM applies to the US stock market by studying intercept terms and regression coefficients.

Table 2: The performance of some companies in S&P 500 from January 2020 to December 2022.

Name	Beta	Returns (3 years)
Abbott Labs	0.655	29.99%
AbbVie	0.583	103.35%
Accenture	1.21	61.72%
Activision Blizzard	0.418	46.11%
Adobe	1.27	12.74%
ADP	0.828	70.62%
Advance Auto Parts	1.14	23.97%
Aflac	0.939	113.93%
Agilent Technologies	1.05	112.01%
AIG	1.18	116.07%
Air Products	0.844	54.73%
Alaska Air	1.52	26.11%
Alexandria RE	0.947	-0.35%
Align	1.62	94.54%
Allegion PLC	1.1	6.34%
Alliant Energy	0.511	5.66%
Allstate	0.606	30.77%
Alphabet A	1.09	71.35%
Alphabet C	1.09	70.03%
Altria	0.664	18.49%
Amazon.com	1.25	8.54%
AMD	1.95	122.11%
Ameren	0.429	23.13%
American Airlines	1.54	-11.71%
American Electric Power	0.437	6.72%
American Express	1.19	87.08%
American Tower	0.557	-5.24%

Table 2: (continued).

American Water Works	0.547	12.07%
AmerisourceBergen	0.531	81.65%
Ametek	1.21	117.67%
Amgen	0.634	18.41%
Amphenol	1.24	123.30%
Analog Devices	1.16	120.43%
ANSYS	1.26	45.61%
AO Smith	1.26	73.83%
Aon	0.877	67.77%

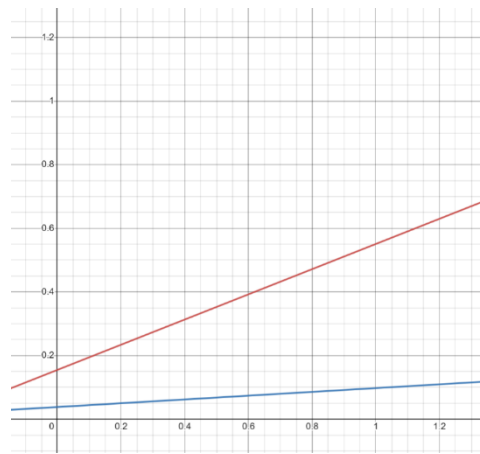


Figure 3: Comparison between regression lines.

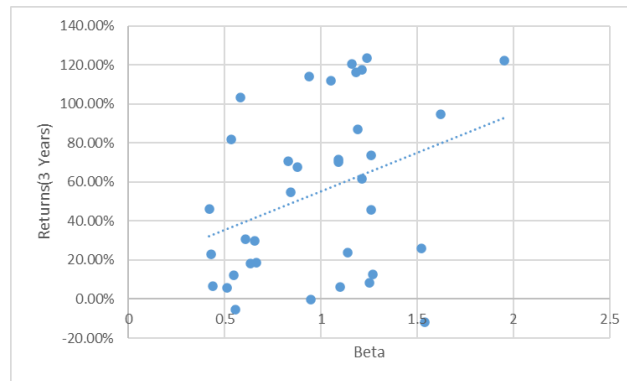


Figure 4: Regression line.

## 5. Conclusion

Since the discovery of CAPM in the 1960s, asset pricing modelling has made big strides. It is advised in the previous financial papers that in the capital market, CAPM should be used to model asset pricing. Soon after, it is proven not capable of achieving its primary purpose even as a continuous fundamental asset pricing model. By the research, the paper test the applicability of CAPM for both Japan and the US. The asset pricing models are constructed with the Japanese and US capital market data for the period from January 2020 to December 2022. The paper obtains the market premium of the two countries from the Kenneth library. The Japanese and US data in the Nikkei 300 index and S&P 500 index are used to build the regression model by the procedures explained in the methodology

section. A thorough test is done by using the rolling regression technique and running 36 cross-sectional regressions. The paper gets large shreds of evidence that CAPM is not applicable in the Japanese market but more applicable in the US market. It can be concluded from the study that CAPM is less valid in eastern markets but still can be a practical model in the developed world.

## References

- [1] Markowitz, H.: *Portfolio selection*. *Journal of Finance* 7(1), 77-91 (1952).
- [2] Markovitz, H. M.: *Portfolio selection: Efficient diversification of investments*. John Wiley (1959).
- [3] Sharpe, W. F.: *Capital asset prices: A theory of market equilibrium under conditions of risk*. *Journal of Finance* 19(3), 77-91 (1964).
- [4] Lintner, J.: *Security prices, risk and maximal gains from diversification*. *Journal of Business* 36, 294-419 (1965).
- [5] Black, F.: *Capital market equilibrium with restricted borrowing*. *Journal of Business* 45(3), 444-445 (1972).
- [6] Stattman, D.: *Book values and stock returns*. *The Chicago MBA: A Journal of Selected Papers* 4, 25-45 (1980).
- [7] Basu, S.: *The relationship between earnings yield, market value and return from NYSE common stocks: Further evidence*. *Journal of Financial Economics* 12(1), 129-156 (1983).
- [8] Investing.: <https://www.investing.com> [Accessed on: 1/03/2023]
- [9] Bloomberg.: <https://www.bloomberg.com> [Accessed on: 1/03/2023]
- [10] Data Library.: <http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html> [Accessed on: 10/03/2023]