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EVALUATING THE EFFECTIVENESS OF CAPM AND APT FOR RISK MEASURING AND ASSETS PRICING

 Fahim Afzal^{1*}
Pan Haiying²

^{1,2}Business School of Hohai University, Nanjing, Jiangsu, PR. China.

¹Email: fahimafzal@mail.com Tel: +8615261858637

²Email: hypan@hhu.edu.cn Tel: +8613851411289



(+ Corresponding author)

ABSTRACT

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Persistent with the problem of quantifying the risk associated with securities, this study examines the applicability and validity of Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT) while evaluating the stock prices and returns of listed companies in the Pakistan stock exchange. While examining the applicability of CAPM and APT, this study considers the stock return of top ten sectors listed in stock exchange from the period of 2014 to 2019. The result shows that the application of APT for risk estimations may not be showing satisfactory results from the observed data. On average, the p-value is more than 30% for all factors which should be less than 5%. Therefore, in order to compare the application of methods and find out the stock risk, it can be concluded that CAPM approach is more reliable than APT. Thus, it is suggested to adopt the CAPM approach to estimate the realistic stock returns. Additionally, the investor can also consider different indigenous and exogenous economic factors according for calculating market risk and maximizing the return.

Contribution/Originality: This study contributes in the existing literature in a way to show that CAPM is still a valid tool to estimate the return in Pakistani capital market, which implies that the market risk can better be estimated by the companies. Investors must consider the market index performance for realistic stock return rather to follow other economic indicators.

1. INTRODUCTION

Pricing an asset is a very technical but crucial phase for investors in the stock markets to predict the future price of the stock, where they are investing. Different techniques have been used by investors to predict the expected prices of assets. Stock investors are always looking for specialized instruments that can capture the risks associated to their investments in order to maximize their profit returns regardless of risk levels. Recently, most efficient methods through which the risk and return can be calculated are Capital Asset Pricing Model (CAPM), and Arbitrage Pricing Theory (APT) are two models, which are useful to predict the expected value of stocks and also helpful to individual and institutional investors regarding the pricing of stocks.

This study examines the applicability and validity of CAPM and APT while evaluating the stock prices and returns of listed companies in the Pakistan Stock Exchange (PSX). CAPM of Sharpe (1964) and Lintner (1965) are the presenters of the APT, and there were no asset pricing models that exist in the financial world before the development of CAPM and APT which boosts the trust of investors in order to capture the risks associated to their assets. Till date, the CAPM is being used by investors in risk applications in order to estimate the cost of equity

capital and for portfolios performance evaluation. [Ataullah \(2001\)](#) states that the macroeconomic indicators exchange rate, oil prices, balance of trade and inflation are the principal source of systematic risk in the PSX, and the APT pricing restrictions hold. The findings can help the individual as well as corporate investment managers including brokers efficiently manage the cost of capital estimations.

The quantification of risk is the main challenge for the investors and practitioners that are associated with securities in which they are investing. Therefore, the main objective of this study is to determine how accurately the CAPM and APT predict the expected return from PSX. So in this study from the top ten sectors, ten companies have been selected from each sector according to their high market capitalization. This study helps the individual as well as institutional investors to decide to what extent they can rely on CAPM and APT while making investments in stocks.

2. LITERATURE REVIEW

Nowadays, the stock investors are always having the main focus on how to maximize the returns by minimizing the risks associated to their investments, even if they are investing in the assets or securities or business projects with higher risks. To achieve this target, investors are always wondering to find new tools to quantify the risk and return association upon their investments. Therefore they implement different models for their risk quantifications. In this regard, the CAPM has been widely used by the risk managers for the risk and return quantifications ([Jagannathan & Wang, 1996](#)). Since the development of the CAPM, to evaluate the validity of CAPM, multiple efforts have been ardent, a valuable contribution, and unique development in the field of finance. Some studies that have been conducted related to the use of CAPM support the principle of the model while few contradict the model.

The CAPM of [Sharpe \(1964\)](#) and [Black, Jensen, and Scholes \(1972\)](#) has been proved to be one of the most efficient tools to explain the association of risks and returns briefly. The CAPM model measures the risk of an asset by the covariance of an asset's return with the market return. The linearity of expected returns related to asset covariance of market return is the main implications of the model, called the beta risk that is higher the beta, higher the risk association.

[Qu and Perron \(2007\)](#) explained that if the new CAPM model is providing efficient results in the estimation of returns or not. They used the data set of New York stock exchange from the period of 1978 to 2004 with the sample size of 50 securities on the US stock market and concluded that the CAPM only identifies a single-equation factor which leads to the insignificant findings. Another study conducted by [Elbannan \(2015\)](#) examined the emerging Greek securities market by using the weekly data of 100 companies from the period of 1999 to 2002, listed on the Athens Stock Exchange. Their results do not support the basic statement of CAPM that higher beta leads to generate higher returns. [Al Refai \(2011\)](#) inspected the relationship of risks and returns on Jordan's stock market portfolios by using the monthly data from the period of 1999 to 2008, which concluded that the positive relationship of risk and returns between emerging markets was rejected. [Bhatti and Hanif \(2010\)](#) also examined the CAPM in different institutes of Pakistan. They inspected the CAPM application on PSX to build an opinion about the model reliability and validity by applying to the different institutional frameworks. They studied sixty companies chosen from the KSE-100 index using the data from 2003 to 2008. The variance-covariance approach has been used to calculate the beta in the prediction of desired returns from specific security. According to the results extracted suggested that out of 360 observations, there are only 28 companies supports the CAPM, that accurately measures the systematic risks between the securities, whereas remaining 332 companies does not support the primary application of CAPM, findings suggested that the CAPM gives accurate results for a limited period and few companies only.

[Hundal, Eskola, and Tuan \(2019\)](#) examine the relationship between risk and stock returns in the Finnish stock market, and secondly, they examine to identify the performance of Finnish companies if the realized returns are

under-performed or over-performed. Their principal findings indicated the relationship between risk and returned worked in a synchronized way and stock return of observed companies is observed to be less volatile as compared to the market index.

A multi-factor model known as APT has been developed in need, because many researchers believed that CAPM is unable to capture all the factors that affect the stock returns, which was further used by Ross (1976) as cited in Laubscher (2019). By using this model, it can be determined or explain the relationship between risks and return that an investor wants to take from his investments. Javid and Eatzaz (2009) made compares the conditional multi-risk factor model and CAPM by using the data of 49 companies of PSX from the period of 1993 to 2004. The results concluded that the CAPM model is just applicable and can give satisfactory results for few securities in just a few years. It can be helpful for some times in PSX if the investor is investing in low-risk securities. They concluded that the conditional multifactor model gives much more efficient results as compared to the single-factor model of decision making. Shamim, Abid, and Shaikh (2014) examined the data of 70 companies from the period of 1994 to 2005 listed in the NASDAQ stock exchange. The result concluded that the model for the prediction of future returns had been changed but the CAPM is only useful for the estimation of the cost of capital. Furthermore, when they compared the results generated from CAPM and APT, showed that the APT model gives more accurate measures of future returns ad CAPM gives much less returns than APT.

Iqbal and Haider (2005) examined the portfolios from the Bombay stock market and the National stock market of India. They concluded that the APT model gives more accurate measures than CAPM. Furthermore, they suggested that the APT model explains the process of return generation more accurately than CAPM (Harshita, Singh, & Surendra, 2015).

Dash and Rishika (2011) examined the most important industries in the National stock exchange of India. The main objective of their research was to check the applicability of APT and CAPM in capital markets of India and to check how macroeconomic factors play their role in the generation of securities returns. The results of their research suggest that the APT model does not have adequate power when compared to CAPM in Indian stock markets. Numerous studies have been done to check different economic factors and their influence on the stock market returns but the majority concluded that APT is far better than CAPM.

Siregar and Diana (2019) study the Indonesia stock exchange using the sample data of 194 companies from the period of 2007 to 2017 to examine the macroeconomic factors on stock returns by using the APT approach. The findings of their research depict that different economic factors have different influences on the stock returns and they categorized the period in three observational ways that include economic growth, increase stock returns and Increased market risk. The solidification of the rupiah concerning the USD is a significant signal for stock market investors who had full confidence in the country's economic situation. Political risk studied to be one of the factors that are important in determining the stock returns comparative to market risk and macroeconomic factors.

3. RESEARCH METHODOLOGY

The research purpose is to check that “which model is applicable on PSX for CAPM or APT?” For this purpose, the following methodology has been used, and through different studies from different articles, it will also guide an investor that whether CAPM or OPT provides valid results in PSX, and does it prove to be helpful to the investors?

PSX has been selected for this study by considering ten sectors of PSX from the period of 2014 to 2019 see Table 3. Furthermore, to simplify the study, from each selected sector, only one company has been chosen based on market capitalization. Secondary data is taken, which has been collected from different reliable sources. The primary source is the official websites of PSX. Other sources are financial statements, national security website and Google Finance. Secondary data (a stock price or the share prices of the companies) considered for this study, have been

taken from the website of PSX. CAPM and APT have been used to calculate the expected return of the stocks. Because by using these models on both stocks, then they will guide the investors to invest in which type of stock.

3.1. Capital Asset Pricing Model

The CAPM is a model that explains the relationship of risk and returns, and that is utilized in risky portfolios pricing. Risk and the time value of money are the two key ways that need to be compensated in the CAPM model. In equation 1, the risk-free rate is the time value of money and compensates the investors to invest their savings in any security over some time. The second half of equation 1 represents the risk and helps the investors to estimate the compensation amount that needs to have additional risk. This is calculated by estimating the risk-measure (beta) that compares the asset returns to the market over a period and to the market premium. CAPM has been calculated by Equation 1;

$$\mathfrak{R}_{es} = \delta - \beta(\mathfrak{R}_{em} - \delta) \tag{1}$$

Where \mathfrak{R}_{es} signifies the expected stock returns. δ is the return on risk-free rate \mathfrak{R}_{em} shows the market Return and β is Covariance of stock and market / Variance of market.

3.2. Arbitrage Pricing Theory

The APT model explains the relationship of single assets by using the linear combination of macroeconomic factors and the returns of portfolios. The APT defines the price where a mispriced asset is likely to be. Since the assumption power and requirements of APT considered to be very flexible but considered to be as an alternate of CAPM. Whereas the CAPM requires the expected market return, but APT only requires the expected returns of the assets that are risky and risk premiums of different macroeconomic variables. APT is calculated by Equation 2;

$$\mathfrak{R}_{ea} = \zeta + \gamma_1\rho_1 + \gamma_2\rho_2 + \gamma_3\rho_3 + \gamma_4\rho_4 + \dots + \gamma_n\rho_n \tag{2}$$

Where the rate of return of an asset is \mathfrak{R}_{es} , ζ labels the risk-free rate γ_1 shows the asset returns sensitivity of specific macroeconomic factors and ρ_1 is the risk premium related to the specific macroeconomic factor. And Asset returns Π have been calculated by Equation 3, where Ω_1 reflects the recent price of stocks and Ω_0 is the price of stocks last month.

$$\Pi = \frac{\Omega_1 - \Omega_0}{\Omega_0} \tag{3}$$

Figure 1 of a framework shows that APT has four independent factors, which include inflation, money supply, unemployment & foreign exchange rate, and one dependent factor which is expected stock returns. These four independent factors can influence on expected stock returns. CAPM has only one factor that is market risk premium which can influence on expected stock returns.

4. DATA ANALYSIS

Our research results are showing significant results by regression analysis from data that has been used in this research. Because the results of the p-value for all companies is showing less than 5% except PPL. On the average T-Stats is showing positive signs. Moreover, r-squared is showing insignificant results with an average of 26% of explanatory power see Table 1. However, APT was not showing the most satisfactory results in PSX from selected

data in this research. Because on p-value it is more than 30% for all factors which have been used in the APT model & it should be less than 5%.

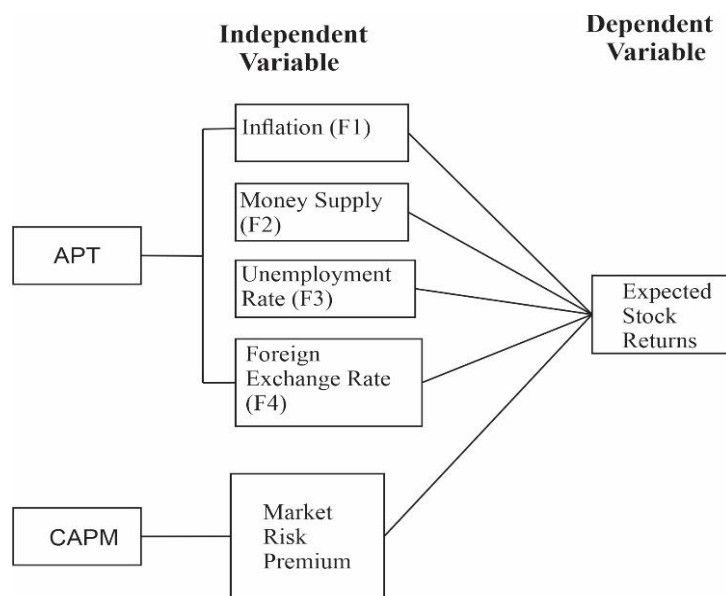


Figure-1. Theoretical framework.

On the other hand, the average value of t-stats is showing a negative sign for the inflation factor see Table 2. Moreover, showing a positive sign for the other three factors. Furthermore, average explanatory power is 9.8% see Figure 2 and Figure 3.

Table-1. Results of the CAPM model.

Index	R-Squared	T-Stat	P-Value	Significance
LUCK	0.340	5.471	0.000	0.000
ENGRO	0.257	4.477	0.000	0.000
KEL	0.257	4.482	0.000	0.000
PTCL	0.265	4.577	0.000	0.000
PPL	0.002	0.328	0.744	0.744
Nishat	0.506	7.710	0.000	0.000
MCB	0.538	8.212	0.000	0.000
AICL	0.287	4.828	0.000	0.000
FFC	0.152	3.224	0.002	0.002
UPFL	0.052	1.787	0.079	0.079

Table-2. Results of the APT model.

Index	R-Squared	Beta	Inflation	Money Supply	Unemployment	Forex
LUCK	0.084	0.960	0.301	0.905	0.633	0.075
ENGRO	0.078	0.301	0.755	0.072	0.133	0.923
KEL	0.019	0.642	0.463	0.685	0.757	0.804
PTCL	0.092	0.684	0.232	0.094	0.165	0.598
PPL	0.025	1.442	0.384	0.965	0.518	0.963
Nishat	0.162	1.678	0.266	0.022	0.262	0.155
MCB	0.154	1.112	0.461	0.021	0.913	0.240
AICL	0.141	1.462	0.203	0.007	0.233	0.667
FFC	0.044	1.280	0.700	0.472	0.703	0.246
UPFL	0.186	1.524	0.646	0.185	0.003	0.467

APT may not be showing satisfactory results from the observed data. On average, the p-value is more than 30% for all factors, which should be less than 5%. The average value of t-stats is negative for inflation and the other three factors are positive.

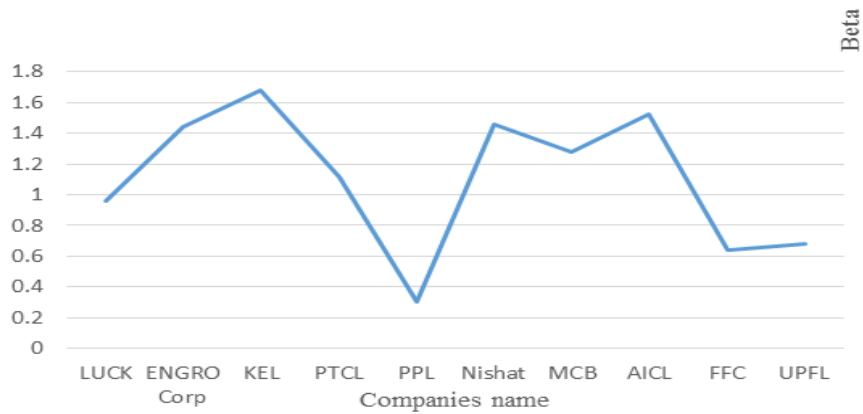


Figure-2. The beta of CAPM for PSX.

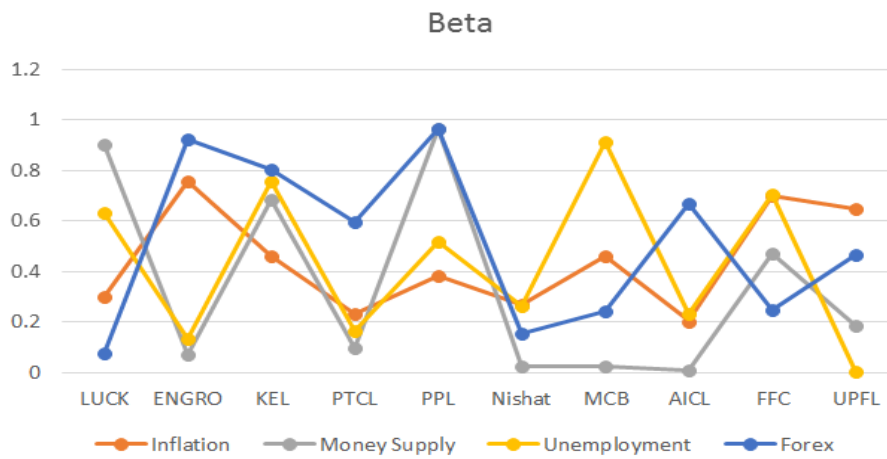


Figure-3. Betas of APT for PSX.

5. CONCLUSION

This study has been done with several objectives in mind. First of all, it was to determine which model is providing more significant results for expected stock returns. For this purpose, time series analysis has been done for five years using two models CAPM and APT. The other objective was to determine which stock exchange gives more return based on the estimation of these models. For this purpose time series analysis has been done for PSX taking ten companies from each sector. Firstly the explanatory power of PSX CAPM and APT 26.4% and 9.47% respectively. Overall, CAPM is showing more significant results for the stock exchange, whereas APT is showing mixed results and for factors like unemployment rate and exchange rate, they are not even close to significant. The average p-value for both factors is 58% and 60% respectively which should be less than 5%. So based on these results, it can be concluded that CAPM is more reliable than APT. As far as APT is concerned, it cannot be denied that the sample was short and some factors work differently on different companies. So, if there would have been different factors like GDP growth rate or oil prices, then maybe there would have been different and more reliable results for APT. According to the results of this study, CAPM is suggested for investors to estimate the stock returns but an investor can also use different factors according to his requirements for APT as every factor affects differently on the APT model. For further research, new researchers can take a more than five-year time span and also take other factors of APT like oil prices and GDP growth rate to check the validity of APT.

Table-3. List of acronyms.

Index	Abbreviation
LUCK	Lucky Cement Limited
ENGRO	Engro Corporation Limited
KEL	K-Electric Limited
PTCL	Pakistan Telecommunications Company Limited
PPL	Pakistan Petroleum Limited
Nishat	Nishat Mills Limited
MCB	MCB Bank Limited
AICL	Adamjee Insurance Company Limited
FFC	Fauji Fertilizer Company Limited
UPFL	Unilever Pakistan Foods Limited

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