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# Understanding Risk & Return Using CAPM-Evidence from Pharmaceutical Sector at KSE

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### ABSTRACT

The General Concept: Higher Expected Returns Require Taking Higher Risk Most investors are comfortable with the notion that taking higher levels of risk is necessary to expect to earn higher returns. In this note, we explain Capital Asset Pricing Model (CAPM) that has been developed to make this relationship precise. By applying CAPM to Pharmaceutical sector at Karachi Stock Exchange we examined that Beta ( $\beta$ ), the measure of systematic risk in CAPM, has significant impact on returns of the securities.

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### Introduction

Why should riskier companies have higher returns? Intuitively, an investor would require a higher *expected* return in exchange for accepting greater risk. To understand this, imagine an investment that is expected to generate Rs.1 million per year in perpetuity. How much is someone likely to pay for such an asset? The answer depends on the uncertainty or riskiness of the cash flows. With complete certainty that the cash flows will all be paid when promised, an investor would discount the asset at the risk-free rate. As the degree of uncertainty increases, the return required to justify the risk will be much higher, resulting in a much lower price the investor would be willing to pay, simply because of the higher required discount rate.

Furthermore, economists have made the assumption that investors are risk-averse, meaning that they are willing to sacrifice some return (and accept even less than the expected present value of the future returns) to reduce risk. If this assumption is true, we would expect investors to demand a higher return to justify the additional risk accepted by holders of riskier assets.

One widely accepted measure of risk is volatility, the amount that an asset's return varies through successive time periods, and is most commonly quoted in terms of the standard deviation of returns. An asset whose return fluctuates dramatically is perceived to have greater risk because the asset's value at the time when the investor wishes to sell it is less predictable. In addition, greater volatility means that, from a statistical perspective, the potential future values of more volatile assets span a much wider range.

Although somewhat counterintuitive, an individual stock's volatility in and of itself, is not the most important consideration when assessing risk. Consider a situation in which an investor could, without incurring additional cost, reduce the volatility associated with her portfolio of assets. This is most commonly accomplished through diversification.

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Volatility can be effectively reduced without significant cost by diversifying, so it makes sense that investors should not be compensated for that portion of volatility which is merely stock specific and has no impact on a well diversified portfolio. This type of volatility is called unsystematic risk in the finance literature because it does not covary with the market as a whole, but is merely the additional random "noise" present in that specific asset's returns. Since this random noise has an expected return of zero, it can be diversified away by adding more securities to the portfolio. Its mean will be zero, and its standard deviation will be reduced as more assets are added. The logical extension of this argument is that with enough assets in a portfolio, the portfolio volatility matches that of the overall market. Thus, investors should only expect to be compensated for the risk that cannot be diversified away i.e. the systematic risk.

### Beta as a Measure of Systematic Risk

As mentioned above, an asset exhibits both systematic and unsystematic risk. The portion of its volatility which is considered systematic is measured by the degree to which its returns vary relative to those of the overall market. To quantify this relative volatility, a parameter called beta was conceived as a measure of the risk contribution of an individual security to a well diversified portfolio:

$$\beta_A = \frac{\operatorname{cov}(r_A, r_M)}{\sigma_M^2}$$

Where

 $r_A$  is return of asset

 $r_M$  is return of Market

 $\sigma^2_M$  is the variance of the return of the market

 $cov(r_A, r_M)$  is covariance between the return of the market and the return of the asset.

In practice, beta is calculated using historical returns for both the asset and the market.

## **Literature Review**

The capital asset pricing model (CAPM) of William Sharpe (1964) and John Lintner (1965) marks the birth of asset pricing theory (resulting in a Nobel Prize for Sharpe in 1990). Before their breakthrough, there were no asset pricing models built from first principles about the nature of tastes and investment opportunities and with clear testable predictions about risk and return. Four decades later, the CAPM is still widely used in applications, such as estimating the cost of equity capital for firms.

To build the intuition for this model, first consider an asset that has no volatility, and thus, no risk; thus, its returns do not vary with the market. As a result, the asset has a beta equal to zero and an expected return equal to the risk-free rate. Next think about an asset that experiences greater swings in periodic returns than the market, or has a beta greater than one. We would expect this asset to earn returns superior to those of the market as compensation for this extra risk.

If we generalize this relationship between expected returns on assets and their exposure to market risk, we are led to the CAPM equation:

$$E(r_A) = r_f + \beta_A (E(r_M) - r_f)$$

Where

$$E(r_A) = r_f + \beta_A (E(r_M) - r_f)$$

 $E(r_A)$  is the expected returns on asset

 $(E(r_M)-r_F)$  is the expected excess return of the market portfolio beyond the risk-free rate, often called the equity risk premium.  $r_F$  is the risk-free rate

Essentially, the CAPM states that an asset is expected to earn the risk-free rate plus a reward for bearing risk as measured by that asset's beta.

The attraction of the CAPM is its powerfully simple logic and intuitively pleasing predictions about how to measure risk and about the relation between expected return and risk. The CAPM was developed, at least in part, to explain the differences in risk premium across assets. According to the CAPM, these differences are due to differences in the riskiness of the returns on the assets. The model asserts that the correct measure of riskiness is its measure— known as beta—and that the risk premium per unit of riskiness is the same across all assets. Given the risk-free rate and the beta of an asset, the CAPM predicts the expected risk premium for that asset.

While the CAPM is an extremely elegant and useful tool, there are concerns about the overall efficacy of the model. Several key criticisms have come to the fore of academic research in recent years. Many researchers believe that other risk factors have significant impact on expected returns in the market. As a result, the simplicity of the CAPM's assumption of a single risk factor explaining expected returns has been called into question. These critiques are in many ways interrelated; improvements in any one of these areas are bound to have an effect on others. Because the predictive and explanatory power of the CAPM is bound by the structure of the model, it is the assumption of a single risk factor which has spurred much recent academic research into security price analysis.

It is obvious that there are a myriad of risk factors facing companies today. Some of these factors are market risk, bankruptcy risk, currency risk, supplier risk, etc.; and given that the CAPM uses a single factor to describe aggregate risk, it seems logical that a model including more sub-factors might provide a more descriptive and predictive model. Effectively, additional factors allow more specific attribution of the risks to

which a company is exposed. The single risk factor can be decomposed along multiple dimensions.

Furthermore, from a statistical perspective, the addition of independent variables to a regression often improves the explanatory power of a model. For these reasons, multifactor models relax the assumption and constraint of a single risk factor and look for other factors that affect expected return to assets.

With academics debating the value of the CAPM, what are companies that now use it in their capital budgeting process to do? May be nothing different. Obviously, capital budgeting decisions were made before there was a CAPM, and they can be made again without it. But the data seem to suggest that those who choose to use the CAPM now despite the academic debate will actually not be getting worthless advice.

Pettengill et al. (1995) developed a conditional relation between beta and realized returns by separating periods of positive and negative market excess returns. Using the U.S. stock market data in period 1936 through 1990, they found a significant positive relation between beta and realized returns where market excess returns are positive (up market) and a significant negative relation between beta and realized returns where market excess returns are negative (down market). They also found support for a positive risk-return relation. Isakov (1999), following the approach of Pettengill et al. (1995), examined the Swiss stock market for the period 1983 to 1991. He found supportive results that beta is statistically significant related to realized returns and has the expected sign. Hence, Isakov (1999) concluded that beta is a good measure of risk and is still alive. This has prompted us to test the following hypothesis

Ho: Beta has significant impact on returns of equity H1: Beta has insignificant impact on returns of equity

# Data

In order to test our hypothesis, time series data was obtained from Karachi stock exchange (KSE). Monthly prices of stocks of pharmaceutical sector that included seven firms were taken for five years. The period was from year 2003 to 2008.

### Methodology

In order to study the impact of Beta on required returns, yearly betas were calculated for each firm in pharmaceutical industry four five years.

To calculate  $\beta$ 's, as a first step first prices are changed into returns as follows:

$$R_{t} = \frac{p_{t}}{p_{t-1}} - 1$$

 $p_t$  = Price of the current period

 $p_{t-1}$  =Price of the previous period

 $R_t$  = Return of the current period

KSE 100 index is used as proxy for market portfolio and Rate of 12-Month Treasury bill is taken as proxy for risk free rate of return.

Mean return of market is determined and then converted into Annual percentage rate as below:

$$APR = (1 + \overline{R}_m)^n - 1$$

Where  $R_m$  is Average return of market and n = 12

Movement of security with the market is calculated in the second step. Finally  $\beta$  's can be determined by using

$$\beta_{s} = \frac{\sigma_{s,m}}{\sigma_{m}}$$

Required rate of return for each security is found by using the following equation

$$APR = (1 + \overline{R}_m)^n - 1$$

 $R_{s}$  = Required rate of return

 $R_f$  = Risk free rate of Return. Rate of 12-Month Treasury bill is taken as proxy for risk free rate of return. This is equal to 0.099908

### $R_m$ = Market Return

Repeating this process for each year we calculated 35 returns and corresponding 35 betas.

### **Regression Analysis**

Required returns were taken as dependent variable while Betas were taken as independent variable. The result obtained was as follows





It is evident from the statistics that beta has significant impact on Returns. Its p-value is zero and  $R^2$  values implies that the model is explaining 74% effect on beta. The significance of t-statistics implies that we accept H<sub>0</sub>.

## Table 1: Returns with their corresponding Betas.

Returns	Beta			
0.401922338	0.495179023			
0.034532528	-0.078059445			
1.268624367	1.847494547			
0.410638078	0.508778196			
0.608823593	0.818007134			
0.512612333	0.667888667			
0.172094604	0.419090711			
0.02270143	-0.192833476			
0.066646767	-0.055843645			
0.223824728	0.434123751			
0.265051056	0.562637677			
0.307677153	0.69551507			
0.484640946	1.247160406			
0.404043424	0.995915526			
0.438050854	0.68988901			
0.179726527	0.181262246			
0.128592918	0.080582909			
0.36302312	0.54216342			
0.398249277	0.611521835			
0.235038192	0.290167952			
0.152362216	0.127383384			
0.085011732	0.539479283			
0.086221856	0.409800667			
0.089003873	0.111675801			
0.0852269	0.516421654			
0.089599078	0.04789284			
0.084917776	0.549547825			
0.086260315	0.405679445			
0.367763268	0.804918543			
0.099558751	0.01510616			
0.063698966	-0.090494231			
0.383546742	0.851397936			
0.322806409	0.672528961			
0.519298521	1.251161656			
0.05842865	-0.106014329			
arossion Analysis for Date				

Table 2: Regression Analysis for Return
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Variable	Coefficient	Std. Error	t-Statistic	Prob.
С	0.042666	0.031132	1.370479	0.1798
BETA	0.474706	0.048052	9.879024	0
R-squared	0.747311	Mean dependent var		0.271435
Adjusted R-squared	0.739653	S.D. dependent var		0.241256
S.E. of regression	0.123099	Akaike info criterion		-1.29622
Sum squared resid	0.500058	Schwarz criterion		-1.20734
Log likelihood	24.68379	F-statistic		97.59511
Durbin-Watson stat	1.212298	Prob(F-statistic)		0

#### Conclusion

The results verified the claim that risk has significant impact on the returns and the  $R^2$  value of 74% has also shown that capital asset pricing model has accurately explained relationship between risk and required return but still 26% of variation is not explained by the model. Thus we can conclude that CAPM is still useful despite of its short comings.

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