BETA

WHAT IS BETA

Beta (β) or Beta Coefficient in finance is the measure of risk which arises from the exposure due to general movements in the market as opposed to distinctive factors. Beta is considered as the measure of systematic risk of the stock and it measures the volatility of stock or a stock portfolio in comparison with the benchmark index of a stock market.Capital asset pricing model (CAPM), which is widely use to predict the expected return from the stock uses Beta as a key variable in the equation. The CAPM equation is written as follows – $Er = Rf + \beta(ERm - Rf)$

Where

- Er = expected return from a security
- Rf = Risk Free return of a security (normally the treasury rate or the government bond rates)
- ERm – Rf = market risk premium which is the difference between expected return from the market and risk free rate.
- **β = Beta of the investment**

Beta is defined as the measure of volatility, or systematic risk of a stock or security or the portfolio of stock or security in comparison to the benchmark market performance or overall market. Normally beta is computed using regression analysis and the beta of 1 indicates that the security will move along with the market.

SYSTEMATIC AND UNSYSTEMATIC RISK

Macroeconomic factors are the reason for systematic risk, and such risks are also termed as market risk or volatility risk or non-diversifiable risk, and such risks are beyond the control of individual or firm. Unforeseen events which happen in everyday life of investors are part of such risks. All the investments and securities in the market suffer from systematic risk and it is important to discover such risks as it cannot be avoided by diversification of portofolio. Thus the systematic risk content in the past data can be judged by its beta value.

To measure the systematic risk of the equity traded in the exchange, the price of the security will be compared with the benchmark index of such exchange and this measure is termed as “Beta”. Systematic risks impact all the companies in the entire industry and not a single company.

Unsystematic risk are related to uncertainty in relation to a specific firm, stock or industry and, these issues can be mitigagted by diversification.

Examples of systematic risks include interest rate changes or hike in interest rates, inflation, natural disasters, change to laws, tax reforms, political instability, changes in the foreign policy and change in the currency value, recession in the economy, failure of financial institutions, etc. All the companies in the market will be influenced by surprise about inflation to some extent. Suppose a stock tends to go up on the news due to exceeding expectations of inflation, it will be said that it is positively related to inflation, if the stock goes down in case of exceeding inflation expectation or when inflation falls short of expectations then it is negatively related. The case when stock is not correlated with inflation surprises, inflation has no impact on it.

SOURCE OF BETA

We can compute the beta on our own and computed beta is available on several financial sites which provide readily calculated beta of various years, viz. beta of one year, two-year, three years and so on (sometimes provided betas are computed with time frames not known). The prime risk an investor takes by using the market published betas are, firstly, it is not know that what are the variables used by these websites, and secondly such beta may not be adaptive to the unique portfolio of the investor.

The penultimate users of beta are scrambled with a typical problem in measuring the portfolio risk. A investor who wants to invest for long-term wants to measure the risk over a long term as compared to a investor who typically is a trader and is frequently varying the portfolio. Similarly, the index used as the benchmark to compute beta by the financial website also varies as most of the developed and developing countries have numerous benchmark index. Beta of the security will vary with the use of different benchmark index and thus, the readily available beta may be confusing to the investor. Even the method and the time period used to compute beta by these finance websites are not known.

Knowing the limitation of published beta we can calculate our own beta, an thus, we can adjust for such differences, which enables to ceate a more holistic view of measure of risk. We can

compute and customize our own beta in several ways, depending upon our own portfolio, the time horizon of investment, and other factors which we wish to consider. We can customize the beta and measure the reliability by computing the r squared (R^2) often acknowledged as the coefficient of determination. R^2 is the statistic, whose range is zero to one and it determines that how well beta measures the risk level. The reliability bo beta is measured using the value of R^2 and if R^2 is close to one it depicts high reliability of beta. The computation of beta better explains the expected return of the stock as compared to the market published beta, as the investor decides the time frame, align with the portfolio, and then choose an appropriate index. Once the desired data is available, we can compute the beta of security or portfolio.

COMPUTATION OF BETA –

In the note we will discuss computing beta in two different ways, Firstly, beta can be computed applying the statical formula of **covariance[1] -** Statistically, beta is calculated as –

$$Beta = \frac{covariance\ between\ returns\ from\ market\ portfolio\ and\ those\ from\ particular\ security}{variance\ of\ marekt\ portfolio}$$

OR

$$\beta_i = \frac{\sigma_{im}}{\sigma_m^2} = \frac{covariance\ with\ the\ market}{variance\ of\ market}$$

OR

$$\beta i = \frac{Covariance_{\ i,m}}{\sigma_m^2}\ i.e. Cov(X,Y) = \sum \frac{(X_i - \bar{X})(Y_j - \bar{Y})}{n-1}$$

Where

$\sigma_{im} = covariance\ between\ stock\ return\ and\ the\ marekt\ returns$

$\sigma_m^2 = variance\ of\ the\ returns\ on\ the\ market$

[1]Statistical measure that measures the joint variation between the two variables. In finance and investment analysis this is used to value the co-movements form a portfolio of stock with the return from benchmark market index. The mean value of a variable is computed and if the mean value of other variable tends to be above the mean value of the variable it infers positive covariance between the two variables. Whereas if the other mean value trend is lower than the mean value of the first one, than it infers the negative covariance between the two variables. Unlike the correlation coefficient, whose range lies between ±1, the value of range of covariance is unrestricted .) $\frac{\Sigma xy}{n}$ $where\ x\ is\ X - average\ value\ of\ X; y = Y - average\ value\ of\ Y$

$X_i = the\ value\ of\ the\ X - variable$

$\bar{X} = the\ mean\ (average) of\ the\ X - variable$

$Y_j = the\ values\ of\ the\ Y - variable$

$\bar{Y} = the\ mean\ (average) of\ the\ Y - variable$

$n = the\ number\ of\ the\ data\ points$

In Microsoft – Excel beta can be computed using the slope coefficient function or the 'covar' and 'var' function. An example of beta computation in excel is provided along with the note.

Table 1 illustrates the example to compute beta using the covariance method by applying the equation stated above. The step to cmpute beta is given below the table.

EXAMPLE

Day	Market Rate of return	Return on Individual equity	Deviation from average of market rate of return	Deviation from average of return on individual equity	Sum of square of deviation Column (d)	Sum of square of deviation column (e)
	1	2	3	4	5	6
1	-7%	-12%	-9	-15	81	225
2	-8%	-7%	-10	-10	100	100
3	4%	7%	2	4	3	16
4	12%	9%	10	6	100	36
5	5%	19%	3	16	9	256
6	8%	12%	6	9	36	81
7	-6%	-11%	-8	-14	64	196
8	3%	2%	1	-1	1	1
9	7%	8%	5	5	25	25
10	2%	3%	0	0	0	0
	Average = 2%	Average = 3%			420	936

From the above tables and given data, Beta can be computed following the below six steps

1. Compute the average return on market and average return on individual equity as computed in column 1 and column 2.
2. For each of the asset, we need to compute the deviation from each return from the asset's average return as determined above. In our table above this is computed in column 3 and 4
3. Next, multiply the deviation of return from the security by the deviation of the return from market. The computation is depicted in column 5 of the table.

4. Further, compute the squared deviation of the market's return. The same is presented in column 6 of the table.
5. Summation of column 6 and 7 is done
6. Beta is computed using the formula mentioned above – the sum of column 6 divided by the sum of column 7.

$$Variance = \ \sigma_m^2 = \frac{420}{10} = 42$$

$$covariance = \ \sigma_{im} = \frac{936}{10} = 93.6$$

$$Beta\ (\beta) = \frac{\sigma_{im}}{\sigma_m^2} = \frac{93.6}{42} = 2.23$$

ASSIGNMENT

QUESTION – 1

1	2	3
Year	**Security X**	**Market portfolio Y**
2011	15	16
2012	14	12
2013	17	19
2014	16	18
2015	13	15
Total	**75**	**80**

The second method of computing beta is using beta is by using the slope coefficient through regression analysis. The slope coefficient can be obtained which is also the beta and is computed using regression statistical technique. The return from the stock is regressed against the benchmark market index return. The following regression equation is used to estimate the beta coefficient of the company

$$\Delta E_i = \alpha + \ \beta_i \times \ \Delta I + \varepsilon$$

Where

$\Delta E = change\ in\ the\ price\ of\ equity\ stock$

$\Delta I = change\ in\ benchmark\ index\ (market\ price)$

$\alpha = intercept\ value\ of\ the\ regression$

$\beta_i = beta\ of\ the\ \ i\ stock\ retrun$

$\varepsilon = the\ error\ term$

Beta computation using both the methods is done in the attachment as an excel sheet. We have considered Apple Inc. as the stock and S & P 500 as the benchmark index for the period July 2009 to July 2019.

METHOD OF COMPUTATION OF BETA IN EXCEL

Excel Instructions: There are four ways that you can calculate a Beta using Excel.

- The first is to use the "=slope" formula. In this formula, the X variable series is the return on the market and the Y variable series is the return from apple Inc. security.
- A second alternative is to calculate the Beta directly as the covariance between the two return series, divided by the variance of market returns.
- A third method is to use the full regression procedure in Excel. Go to "Tools" - "Data Analysis" - "Regression" and click OK. Again, enter the market return series as the X variable and the individual stock return series as the Y variable. When you click OK, you should get full regression output similar to that shown in the worksheet.
- Finally, you can create a regression Beta in Excel using the chart functions. Remember that Beta is just the slope in a regression where market returns are on the X axis and security returns are on the Y axis. To create this type of graph, highlight the two columns of data, with market returns on the left. After highlighting the return series, click on the chart wizard icon (or choose "Insert" - "Chart"). Under chart types, select "X-Y scatterplot" and click Next. Click Next twice more to get to step 4 of 4. In step 4, select "as new sheet" and click finish. When the new chart comes up, select the "Chart" tab at the top of the page, and then select "Add Trendline". Select the "Options" tab, and click the buttons for "display equation" and "display R square", then click OK. This should add both a regression line and a regression equation to your chart. The results should look similar to those shown in the worksheet labelled " Chart".

BETA INTERPRETATION / INFERENCE

As the market is compared with the market itself, thus, the beta of the market will always be one. If the computed value of beta is below one, the inference is that the volatility of the stock when compared with the benchmark market ndex is less volatile. Whereas, if the value of beta is more

than one, it implies that the security or stock is more volatile as compared to the benchmark markete index. Theoretically, it is possible to have a beta value of less than zero, i.e., negative beta. This implies that although the market is gaining the stock price is going done (which is more likely) or the value of a stock is increasing with a decrease in the market (less likely).

EXAMPLE

If beta of a stock is 1.50 this implies that the stock is likely to move by 1.5 percent if the benchmark market index varies by 1 percent. Thus, the stock as compared to the will be treated as riskier because the expected change in the stock is higher as compared to the fluctuation in the benchmark market index. **Annexure – 1 of the note illustrates in tabular form the interpretation of beta.**

The value of beta for a stock is related to the sensitivity of a stock based on its revenue and cash flows in respect to the general economic conditions in the market. In a market when the revenue and earnings of a stock varies greatly in a business cycle, especially in the cyclical industries are expected to have higher betas as they are more sensitive to the systemcatic risk. In comparison to this beta of less sensitive industries (industries not impacted by the normal change in cyclical conditions) will likely to have lower betas.

Example - Beta of Edition International (utility company) – 0.26[2]; Beta of Anheuser-Busch (a beer brewing company) – 1.23; [3] Beta of Kraft- Heinz (food and beverage company) – 0.70. The beta of these companies is relatively low as utility companies tend to be highly regulated and stable and thus are insensitive to fluctuations in the market. Similarly, food, brewing, beverage firms, and their products appear to be unrelated to the booms and busts in the economy. On the other hand, the beta of technology has higher betas as whenever there are shocks in the economy; these stocks have an amplified impact of the stock.

LEVERED BETA (EQUITY BETA)

[2] https://www.reuters.com/finance/stocks/overview/EIX assessed on 29-06-2019
[3] Ibid

“Levered beta”, correspondingly termed as “equity beta”, or “geared beta”, compares the volatility of returns of stock of a company with respect to the benchmark market performance. This measure of risk varies based on capital structure of the company and the leverage. Equity beta enables the investor to measure how sensitive or risky the security be to the macroeconomic risk.

Leverage is the key determinant of beta i.e., leverage measures the component of the firm’s debt compared to stockholders equity. The systematic risk of the firm consists of several risks that may affect the performance of the stock. Such risk includes macroeconomic factors, political events, legal changes etc., and are not possible to be leveraged through diversification. Equity beta considers both the debt and equity in the capital structure of the firm. The capital structure of every firm will be different, and thus, the investor/ analyst is interested in looking at how much risky the assets of the firm are, irrespective of their debt and equity proportion. When the firm has higher debts, much of the profit of the firm is used to service the debts, and in case of increase in debts, the uncertainty of future earnings also increases. This increase surely impacts the security of the firm but they are the result of firms own policy and are not the industry/market risk. Thus, when we remove the impact of debt (financial leverage), we get the unlevered beta, which captures only the risk of a firm’s assets. As the level of debt and capital structure are different for different firms, it is desirable to consider unlevered beta for effective comparison with the market.

Equity or levered beta allows investors to measure the sensitivity of the security based on the macro market risk. The default beta figures as displayed on the financial websites or database like Bloomberg is always levered beta which also reflects the debt of the firm. The capital structure of all the firms operating in the market are different. The objective of any analyst who wish to use beta irrespective of the percentage of debt and equity of the firm is to look at riskiness of the assets of the company.

UNLEVERED BETA

“Unlevered beta” also termed as “Assets Beta”, is beta without the impact of debt of the firm. It shows the volatility of earnings by not taking into consideration the financial leverage of the firm. As it measures the volatility of the firm without considering the leverage, it is also termed as ‘assets beta’, as it is a result of only its assets. The basic inference of unlevered beta is that it measures

the risk of an unlevered firm to the risk of the market. Un-levering the beta surely removes the benefits received by the firm due to adding of debt in the capital structure, especially when the firm's debt is less than cash (net debt is negative).

METHOD OF COMPUTING LEVERED AND UNLEVERED BETA

- Formula for computing unlevered beta

$$Assets\ Beta\ (Unlevered\ beta) = \frac{Equity\ Beta\ (levered\ beta)}{\left[1 + (1 - tax\ rate)(\frac{debt}{equity})\right]}$$

- Formula for computing levered beta

$$equity\ beta\ (levered\ beta) = unlevered\ beta\ \times \left[1 + (1 - tax\ rate)(\frac{debt}{equity})\right]$$

Using the above two formulas, if we want to determine the risk of the firm not having any debt, we will remove the impact of the debt, i.e., we will un-lever the beta. Most of the database like 'Bloomberg', 'yahoo finance', 'Thompson Reuters' etc. publish the beta which is levered. Thus, using published/computed levered beta and the capital structure of the firm, we can compute the unlevered beta of the firm.

Hamada's equation is the term used to separate the financial risk of a levered firm from the business risk. Hamada equation is developed using the basic assumptions of the capital asset pricing model and the Miller & Modigliani model. It determines that the financial and the operational risk of the firm determines the beta. Thus, even if the firms in the same industry sector may have same operating risks, they may have different betas because of different capital structure.

This introduces what we call the pure play beta or the unlevered beta. If the firm operating in the same industry sector are having no leverage or debt, they will not have any financial risk and their beta may be same as they will have similar operational risks.

EXAMPLE

We consider 4 firms here (AB Ltd., CD Ltd., EF Ltd., and GH Ltd.)

	1	2	3	4	5	6

	Equity Beta [4](Raw beta)	Total Debt [5]($)	Market value of equity[6]	Debt/ Market value of equity	Income tax rate	**Asset beta**
AB Ltd.	1.81	6154	63,443	9.70%	33%	**0.262046**
CD Ltd	1.63	7123	18,732	38.03%	33%	**0.925106**
EF Ltd	0.73	3267	15,482	21.10%	33%	**0.229916**
GH Ltd	0.82	5232	8236	63.53%	33%	**0.777482**
Mean	1.2475	5444	26473.25	0.33088448	0.33	**0.548638**
Median	1.225	5693	17107	0.295638815	0.33	**0.519764**

The following steps were followed to compute the beta from levered to unlevered, i.e., from equity beta to asset beta.

Step 1 – beta of the four firms was taken from a database along with the debt (if the market value of debt is available that should be considered), the market value of equity and the tax rate applicable. This information is put in column one, two, three, and five, respectively.

Step 2 – we computed the debt-equity ratio using the formula debt/market value of equity. The same is computed in column four.

Step 3 – the asset/ unlevered beta was computed using the following formula

$$Beta\ (Unlevered\ beta) = \frac{Equity\ Beta\ (levered\ beta)}{\left[1 + (1 - tax\ rate)(\frac{debt}{equity})\right]}$$

ASSIGNMENT QUESTION – 2

	Equity Beta (Raw beta)	Total Debt ($)	Market value of equity
X Ltd.	2.34	3334	5134
Y Ltd	1.23	1967	8,732
Z Ltd	1.67	2131	5,482
M Ltd	0.42	7216	1,936
N Ltd	0.91	4187	12,371

[4] Equity beta as provided on the financial website or published data.

[5] Total debt of the firm as per the balance sheet/ statement of financial position

[6] Market value of equity can be computed using the market price of security or stock on a given day multiplied by number of equity stock outstanding.

OVERALL BETA

We may also calculate the overall beta of the firm. This is referred to as the firm beta or overall beta or Asset beta. It indicates the expected change in return from the firm when the return from market portfolios varies by 1 percent. Overall beta is a weighted average of equity beta and debt beta.

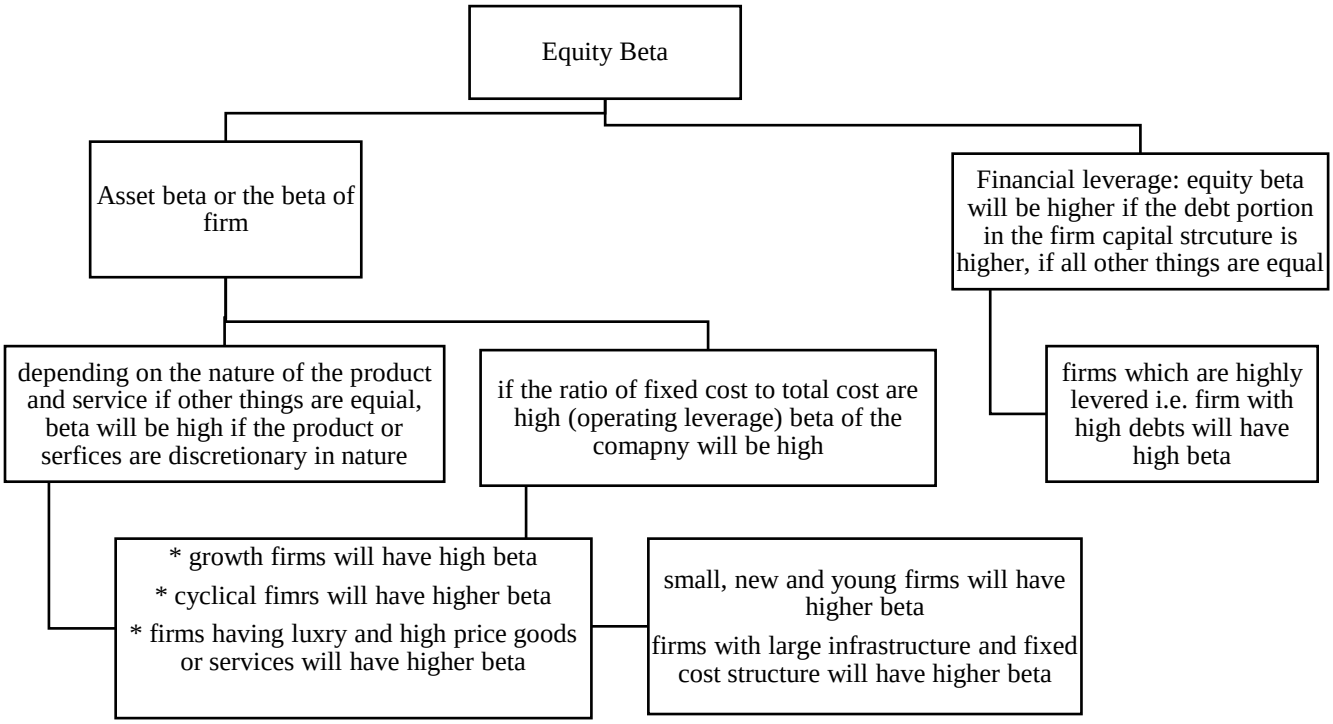
$$Overall\ beta\ (if\ tax\ ignored) = Debt\ Beta\ \times \frac{D}{D+E} + Equity\ Beta\ \times \frac{E}{D+E}$$

$$Overall\ bera\ (tax\ considered) = Debt\ Beta\ \times \frac{D(1-t)}{D(1-t)+E} + Equity\ Beta\ \times \frac{E}{D(1-t)+E}$$

The Miller-Modigliani approach (MM approach) believe that the overall beta of the firm is not affected by the change in the capital structure.

DETERMINANTS OF BETA – SUMMARY

the following chart summarize the basic determinents of Beta (Damodaran, 2002)



ADJUSTED BETA - Sometimes the beta is adjusted.

When we compute the beta or the beta which are available on most of the financial websites are based purely on the historical data and are unadjusted betas. As this estimate of beta which is based

on the historical returns of the security and index is likely not to be a decent indicator of the future. This typically in finance is termed as "beta instability problem". Over time, statistically, the beta may exhibit the mean-reverting properties, i.e., the beta seems to revert to mean, which means that the higher beta will tend to fall back to 1 and the lower beta will tend to rise to 1. Analysts in such cases to compute the predicted returns from the security create an adjustment calculation for the historical beta and compute the "Adjusted Beta". Bloomberg exhibits both the historical (raw) beta and the adjusted beta. By using the past data of the stock it is assumed that over time the beta of the security will tend to move towards the average market and thus beta needs to be adjusted. Following formula is used to adjust the beta –

Adjusted beta = (.67) * Raw beta + (.33) * 1.0.

As beta has the mean-reverting property, this inferest that the adjusted beta will move closer to 1. The value of adjusted beta will be less than unadjusted beta if the unadjusted or historical beta is greater than 1 and it will be more than unadjusted or historical beta if the historical beta (unadjusted) is less than 1. In the above example, the beta can be adjusted using the suggested practice in the finance literature. The literature suggests that 67% weightage should be given to equity beta, and 33% weightage is given to 1, which is the market average. the assumption considered by the adjusted beta is that a security's true beta will tend to move towards 1, which is the market average over time.

The below table shows the computation of beta considering adjusted beta rather than raw equity beta.

	Equity Beta (Raw beta)	Total Debt ($)	Market value of equity	Debt/ Market value of equity	Income tax rate	Adjusted Beta	Asset beta
AB Ltd.	1.81	6154	63,443	9.70%	33%	1.5427	0.223347
CD Ltd	1.63	7123	18,732	38.03%	33%	1.4221	0.807113
EF Ltd	0.73	3267	15,482	21.10%	33%	0.8191	0.257979
GH Ltd	0.82	5232	8236	63.53%	33%	0.8794	0.833802
Mean	1.2475	5444	26473.25	0.33088448	0.33	1.1658	0.53056
Median	1.225	5693	17107	0.295638815	0.33	1.1508	0.532546

Both the levered and unlevered beta are critical and important; however, the firm's capital structure is important to be taken into consideration before coming to any conclusion. needs to be understood. Appropriate adjustments shall be made to come up with the beta associated with the respective firm.

ASSIGNMENT QUESTION NUMBER – 3

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	Equity Beta	Tax Rate	Debt ($M)	Equity ($M)
Equity 1	1.32	34%	535	2376
Equity 2	1.19	32%	0	14,293
Equity 3	0.98	27%	-246	3,376
Equity 4	1.69	33%	763	1023
Equity 5	1.46	29%	1023	9134

COMPUTATION OF BETA OF A PRIVATE FIRM - We can derive beta of the private firm using the comparable public company data –

The process of computing beta mentioned above is appropriate for publicly listed companies whose historical stock price are available. As the data of private company are difiuclt to find or the data is not available in the public domain, it becomes difficult to estimate the beta of such firms. Thus, we must compute or estimate the beta of private companies using the data of public company which is of similar type or comparable with the private company for which we are computing the beta. The approach we follow for this is –

Firstly, we compute the beta/average beta/weighted average beta of such firs which are publicly traded, opeates in the similar operations and/or generates income from similar operations as of the private company. This act as the proxy for the industry average equity or levered beta. Further, we un-lever the beta by the average debt-equity ratio of these comparable firms. And finally, we re-lever the beta by using the target debt-equity ratio of the private company.

EXAMPLE

Suppose we wish to compute the beta of a company into the IT sector with a debt-equity target ratio of 0.6, and we are able to identify the following firms which are the most comparable firms:

Comparable firms 31.12.2018	Beta (β)	Debt	Equity	Debt/Equity

X Ltd.	1.6	15,680	32,534	0.48
Y Ltd.	1.65	21,130	75,700	0.28
Z Ltd.	1.71	1,046	3,306	0.32
A Ltd.	1.69	3,256	8,156	0.40
Average Beta	**1.6625**			
Weighted average beta	**1.64**			
Weighted average debt/equity	**0.34**			

As seen in the table, the average beta is 1.6625, and the weighted average beta is 1.64. The choice of method, whether simple average or weighted average, depends on the data and range of comparable companies. If in the comparable firms, we have a few small companies and one very big company than a beta will be biased towards the large company. in the example cited above, as the weighted average beta is close towards the average beta, we can consider the weighted average beta giving equal weight to equity of each company. Using the formula cited above, we un-lever the beta. To do this, we compute the average debt-equity ratio, which is 0.34 in the above example.

$$\beta_u = \frac{\beta_l}{1 + (1 - t) \times \frac{D}{E}} = \frac{1.64}{1 + (1 - 0.35) \times 0.34} = 1.343$$

Further, in the next process, we re-lever this beta using the target debt-equity ratio of the private company which in our case is 0.6

$$\beta_l = \beta_u \times (1 + (1 - t) \times \frac{D}{E} = 1.343 \times (1 + (1 - 0.35) \times 0.6) = 1.86677$$

In the present example, the beta of this private company is higher than the average beta of comparable companies due to the target higher debt-equity ratio.

"EARNINGS BETA APPROACH - Deriving beta of the private firm

The comparable method used above sometimes has certain drawbacks. It disregards the difference between the size of a public company and the private company and majority of the times the firms which are publicly traded are of bigger size as compared to the private firms. In lieu of the above, we can use the "earnings beta approach to compute the beta of private firms. Firms like Apple Inc., which are diversified and are huge, will be biased comparable for the private firm in question. In such cases, we can use the earnings beta as a proxy for the levered beta of the firm. In the earning

beta approach, the earnings of the private firm are regressed against the benchmark index operating in the same market where the firm operates. Once the beta is identified, we can adjust the beta to reflect the firm's future performance. The method of beta adjustment is stated above.

BOTTOM UP-BETA

When the firm is diversified into various businesses and has numerous segments, then firstly, beta is computed for all the segments and secondly the weighted average of all the beta is computed. The following steps are performed to compute the bottom up beta –

(a) Divide the company into the segments in which the firm operates. For example GE operates in approximately 25 segements as compared to Amazon which operates in single segement.
(b) By estimating the risk of each segement separately, beta of each business is computed, which is asset or unlevered beta.
(c) Weighted average of all the beta of various segments is computed assignming the weights of value derived from each independent segement. These are market value wieights of each segments and are estimated. (such estimations can be based on revenues, various multiples of revenue derived from comparable firms etc.)
(d) Finally, the unlevered beta is adjusted using the debt equity ratio of the firm (Financial leverage)

Bottom up beta can overtime change for the company if the mix of business changes or the leverage of the firm changes. This will give different unlevered beta and further a new levered beta. Bottom up beta are not based on histrocial data and the literature suggest such betas are comparatively better than the regression beta and they are more precise.

Annexure – 1

Interpretation of Beta

β<→ stock is less risky β>→ stock is riskier	The beta of the single stock is compared with the return of an index, which is considered as the benchmark against the stock. The risk of the index is fixed, i.e., 1. A beta of lower than 1 means the stock is less risky than the index and the bet higher than 1 indicates that the stock is riskier than the index
High risk = high reward Low risk = low reward	The stock which has low beta will go down not as much as the benchmark index when it falls, and similarly, the stock will not gain as much as the increase in the benchmark index. Whereas, the beta higher than 1 will increase more than the increase in the benchmark index and will go down more when the index goes down.
β = 1	If the beta of the stock you computed is 1, it indicates the if the benchmark index goes up by certain percentage, the stock will also go up by the same percentage, and if the benchmark index goes down by some percentage, the stock will also go down by the same percentage.
Diversified portfolio	An investor should make sure that they put both the high and low beta stocks in their portfolio sot that adequate diversification is present. A decent mix of high and low beta stock in the portfolio will save the investor from any drastic downturn in the market. As the portfolio will have stock with low beta; also, the investor will not be able to have high profits in good times of the market.
β measures the past volatility of a stock.	We must always keep in mind that beta merely measures the violability of stock in the past and thus, cannot reliably predict the future. The stock beta keeps on changing with time, and thus, it is not a very reliable predictive tool.

Annexure – 2

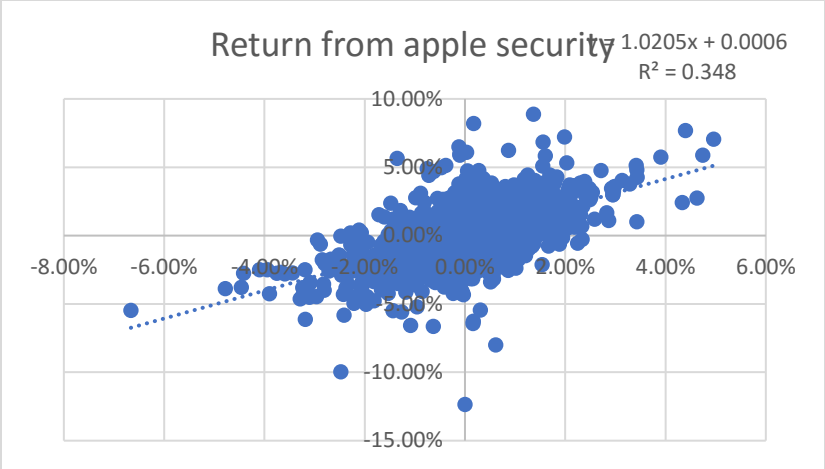
Computation of Beta using Excel

- **Process of computing Beta in excel – (the computation of beta in excel is given along with the technical note. The stock price of Apple Inc from 13/07/2009 to 12/07/2019 is taken, and the S&P 500 index is considered as the benchmark index for the same period.)**
- **The following step is followed for computation of beta of Apple Inc.**
- **Step 1 –** we need 5 columns for computation of beta in excel. In step – 1, we download the data of stock for which we wish to compute the beta. At the same time, we should also download the data of the benchmark index against which the beta of security shall be computed. It depends on the investor/person, regarding the period for which we need to compute the beta. Data for any period daily, monthly, quarterly, yearly must be entered in the excel sheet. The longer the period, the more accurate beta prediction is considered.
    - In our example, we have taken into consideration Apple Inc. share price from 13/07/2009 to 12/07/2019. The beta of apple is computed, taking into consideration the S & P 500 benchmark index. The tentative proforma of columns in excel is given below.
    - In the first column we put date, the second column in the adjusted stock price of apple for the desired period, the third column is the historical closing value of S & P 500 index.

1	2	3	4	5
Date	Apple Inc. Adj Close	S & P 500 Index	Return from apple security	Return from index
13-07-2009	17.81342	901.049988		
14-07-2009	17.80467	905.840027	-0.000491315	0.005316064
15-07-2009	18.38159	932.679993	0.032402684	0.029629918
16-07-2009	18.46169	940.73999	0.004357676	0.00864176
17-07-2009	18.99106	940.380005	0.028674248	-0.000382662
20-07-2009	19.13623	951.130005	0.007643859	0.011431549
. . .				
12-07/2019	203.300003	3013.77002	0.007682791	0.004620175

- Step 2 – from the data downloaded, we calculate the daily return from security and return from the index. We compute the return from security in excel in column four and return from the index in column five. Return from respective security and index is computed by subtracting return by the price of the current day minus the return of previous day divided by the price of the current day, and the same is computed for index. (We leave the first column because to compute the return you need two data points. In this computation, we are subtracting the recent value with the old value, and then we divide the result by old value to compute the return). We have computed this in the excel in column four and five using the formula. The formula used is =(B3-B2)/B2 in column four to compute return from security and =(C3-C2)/C2 for computation of S & P return in column five.

    - Since the return is a calculation over time, you won't put anything in your first cell; leave it blank. You need at least two data points to calculate returns, which is why you'll start on the second cell of your index-returns column. What you're doing is subtracting the more recent value from the older value and then dividing the result by the older value. This just gives you the percent of loss or gain for that period. Your equation for the return's column might look something like this: =(B3-B2)/B2
- Step 3 - Use the copy function to repeat this process for all the data points in your index-price column. Do this by clicking on the small square at the bottom right of your index-return cell and dragging it down to the bottom-most data point. What you're doing is asking Excel to replicate the same formula (above) for each data point.
- Step 4 – Repeat this same process for calculating returns, this time for the individual stock instead of the index. After finishing, you should have two additional columns (column four and column 5), formatted as percentages, which list the returns for both the stock index and the individual stock.
- Step 5 – Plot the data in a chart. Highlight all the data in the two return columns and hit the Chart icon in Excel. Select a scatter chart from the list of options. Label the X-axis with the name of the index you're using (e.g., S&P 500) and the Y-axis with the name of the stock you're using. (in our case Apple Inc.).
- Step 6 – Add a trendline to your scatter chart. You can do this either by selecting the trendline layout in newer versions of Excel or by finding it manually by clicking in Chart → Add Trendline. Make sure to display the equation on the chart, as well as the R2 value. Choose a linear trendline, not a polynomial or moving average. Displaying the equation on the chart, as well as the R^2 value, will depend on what version of Excel you have. Newer versions will let you graph the equation and the R^2 value by clicking on the Chart
    - Quick Layouts and finding the equation R^2 value layout.
    - In older versions of Excel, navigate to Chart → Add Trendline → Options. Then check both boxes next to "Display equation on chart" and "Display R^2 value on the chart," respectively.



- Find the coefficient for the "x" value in the equation of the trendline. Your trendline equation will be written in the form of $y = \beta x + a$. The coefficient of the x value is your beta. The R^2 value is the relationship of the variance of the stock returns to the variance of the overall market returns. A large number, .869 for example, indicates a highly related variance between the two. A low number, .253 for example, indicates a less- related variance between the two.
- standardized since the weighted average of the slope coefficients estimated for all the securities in the index will be one.

- By multiplying the beta value of a stock with the expected movement of an index, the expected change in the value of the stock can be determined. For example, if the beta is 1.3, and the market is expected to move up by 10%, then the stock should move up by 13% (1.3 x 10).