AN INTUITIVE INTERPRETATION OF BETA

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ABSTRACT

The concept of risk is central to finance. Modern Portfolio Theory provides beta as a measure of risk. Despite weaknesses in the theory, beta is widely accepted by academicians and by practitioners as a useful measure of risk. Betas are used for many purposes including the estimation of cost of equity capital for capital budgeting, security valuation, and in public utility regulation. Beta is estimated as a regression coefficient. A variety of sources provide betas for all listed firms. Betas are also needed for individual divisions of multidivisional firms. They are difficult to estimate for individual divisions because those divisions typically don't have individually traded shares.

It is the purpose of this paper to discuss the economic realities underlying that statistic and to provide an intuitive understanding of the economic factors influencing a firm's beta. These factors include the income elasticity of demand for the firm's product, operating and financial leverage and growth prospects for the firm. The relationship between each of these items and beta will be explored.

INCOME ELASTICITY OF DEMAND

Income elasticity of demand reflects the change in consumption of an item given changes in one's income. When the economy as a whole increases or decreases, an area will be impacted according to the nature of its products. Industries that produce necessities or consumables will be impacted less than industries that produce luxuries or durables.

Consider the following. If a typical person's income were to decrease by fifteen percent, how would that affect his/her consumption of, for example, toilet paper, light bulbs, or mustard? The answer is typically-not by much. One probably wouldn't respond to a drop in income by reducing consumption very much. This implies that firm's producing these types of goods would tend to have low betas.

On the other hand, given a drop in income, a typical person would defer purchase of furniture, consumer electronics or other luxuries. Firms producing furniture, high priced consumer electronics, and other luxuries or durables would be impacted more than proportionally. It is relatively easy to delay or eliminate purchase of a luxury or durable. These types of products would yield betas higher than average. Particularly hard hit would be producer's durables. Machines used to produce other products would be affected more severely that the ultimate consumer products. If firms are pessimistic about the future, expansion plans will be put on hold. A relatively mild downturn in the consumer market might translate into a severe recession for producer's durables. Luxuries, durables, and particularly producer's durables typically have high betas.

If income were to rise, those same products that were relatively unaffected by the downturn would also fail to benefit greatly from the upturn. Individually, if one won the lottery, he/she probably wouldn't greatly expand his/her consumption of day-to-day consumables or necessities but he/she would probably spend much more on luxuries.

IMPACT OF LEVERAGE

The underlying beta of a firm is magnified by leverage. Operating leverage is the presence of fixed costs due to operations. A typical break-even analysis shows how operating leverage

increases volatility. Firms with heavy investment in assets will have high operating leverage and this will tend to increase their betas.

Financial leverage is the presence of fixed costs due to borrowing. The Hamada relationship shows the relationship between the underlying unlevered beta and the beta that reflects financial leverage.

$\beta = \beta_{UNLEVERED} * (1+(1\text{-Tax Rate})* (\text{Debt/Equity}))$

Both types of leverage amplify the underlying beta.

Public utilities provide an interesting example illustrating this. They typically have a large investment in assets. They are utilities because they produce necessary goods/services and because economies of scale make them natural monopolies. They are basically very low beta because they produce necessary consumables. They often feel free (or are required by regulators) to use relatively large amounts of debt. Even with the added debt, they typically have lower than average betas. However, when the factors driving the market as a whole change because of big changes in expected interest rates due to government policy or anticipated inflation, the betas of these firms may rise. Although basically low beta, utilities are interest rate sensitive because of the use of debt financing. When interest rates dominate the market some utilities may move more than average firms. The measured betas of these firms would increase. The instability of betas is one of the practical problems of the capital asset pricing model. There have been attempts of deal with this through index models that use more than one market index.

GROWTH FIRMS

In order to remain properly valued a firm that is expected to continue growing rapidly must be more volatile than the market. Burton Malkiel demonstrated this with the following 2-stage growth model. Here we will use the assumptions that no dividends will be paid until the high growth has ended. Upon maturity, the firm will begin paying a dividend and will grow at an average rate for a mature firm.

Assume that G_H is a firm's expected high growth rate and N is the number of years of expected high growth. The firm has current earnings of E_0. In N years (at maturity) the firm's earnings are expected to be

$E_N = E_0 (1 + G_H)^N$.

Upon maturity, it is assumed that the firm will be worth the same Price/Earnings Multiple as other mature firms (M_S). Therefore the Price in year N will be

$P_N = E_N M_S$, which equals

$P_N = E_0 (1+G_H)^N M_S$.

If the cost of capital is K, the price of the firm today should be

$P_0 = P_N/(1+K)^N$, which implies that

$P_0 = M_S E_0 (1+G_H)^N/(1+K)^N$.

The Price Earnings of the growth firm would then be expressed as

$$P_0/E_0 = M_S (1+G_H)^N / (1+K)^N.$$

This equation expresses the price earnings ratio of a growth firm as a function of the price earnings ratio of an average mature firm. If the growth rate (G_H) is greater than the cost of capital (K), the price earnings of the growth stock must be higher than that of a mature firm. This is a reasonable assumption since a firm should not delay paying dividends unless it can earn more than the cost of capital. If the market as a whole goes up or down, then M_S will follow. In order to remain properly valued, the price/earnings of the growth stock must change more than that of a mature stock because $(1+G_H)^N/(1+K)^N$ is greater than 1. The growth stock must be more volatile than an average mature firm and will therefore have a higher beta. Similar results are obtained from more complicated models.

SUMMARY

Firms that produce necessities and consumables will tend to have low betas. Firms that produce luxuries and durables will have higher than average betas. What we have called the underlying beta is then magnified by the use of operating and financial leverage. Growth firms will have higher than average betas.

EXAMPLES

Consider the industry average betas in Table 1. Oil is a necessity and a consumable. Crude oil has a beta of .51. When I ask my classes, which would have a higher beta, brewers or distillers, they usually guess correctly that distillers produce a product that is more of a luxury. The beta for brewers is .65 and that for distillers is 1.13.

People who smoke feel cigarettes are a necessity. Cigarettes have a beta of .74. Drugs and cosmetics are both consumables and they have betas under .9.

Home furnishings are durable goods and discretionary. They have a beta of almost 1.3. Steel and copper are used to produce durable goods including producer's durables. They have betas of 1.4 and 1.2. All of the machinery industries have betas above 1.2. They all are producer's durables and therefore more volatile than average. Radio – TV and electronics both produce durable goods that have luxury aspects. They both have betas well above 1. Radio-TV is 1.7 and electronics is 1.4.

Retail variety and department stores are approximately 1 but food chains are under .8. This seems reasonable since food is less durable than the average products of the other two types of retailer.

The above has shown that betas, which are calculated as statistics, may be understood as reflecting logical economic factors that make intuitive sense.

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TABLE 1

SIC	INDUSTRY	Beta
1311	Oil-Crude	0.51
2082	Beverages-Brewers	0.65
2085	Beverages-Distillers	1.13
2111	Tobacco-Cigarette	0.74
2510	Home Furnishings	1.28
2830	Drugs	0.81
2844	Cosmetics	0.86
3310	Steel	1.44
3331	Copper	1.24
3400	Machinery-Metal Fab.	1.21
3531	Machinery-Construction	1.21
3550	Machinery-Specialty	1.28
3560	Machinery-Industrial	1.24
3651	Radio-T.V.	1.7
3670	Electronics	1.43
5331	Retail-Variety	1.04
5311	Retail-Dept. Stores	1.04
5411	Retail-Food Chains	0.79