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BACHELOR DEGREE PROJECT

β -Values

Risk Calculation for Axfood and Volvo

Bottom up beta approach vs. CAPM beta

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“An investment in knowledge pays the best interest”

Benjamin Franklin

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Risk calculation for Axfood and Volvo - Bottom up beta approach vs. CAPM beta

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ABSTRACT

The aim of this thesis is to study the risk for two Swedish companies, Axfood and Volvo. To test the required return on equity, a bottom-up beta approach and a CAPM regression beta are used. This thesis concludes that the bottom-up beta gives a truer reflection and a more updated beta value than a CAPM regression beta on the firm's current business mix, the CAPM beta takes only the past stock prices into consideration.

The empirical results for Volvo conclude that the levered bottom-up beta is 1.09 and the CAPM β is 0.52 for Volvo. The empirical results for Axfood which is categorized as consumer goods sector implies that the levered bottom-up beta is 0.87 while the CAPM regression beta is 0.29.

Keywords: CAPM, Jensen's measure alpha, Security market line, Bottom-up Betas, Levered Beta, Unlevered Beta, Required return on Equity, Debt Equity ratio.

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Abbreviations

CAL	Capital allocation line
CAPM	Capital asset pricing model
CML	Capital market line
DFL	Degree of financial leverage
DOL	Degree of operating leverage
D/E	Book value debt- equity ratio
M D/E	Market value debt- equity ratio
ICML	Instantaneous capital market line
MCAP	Market Capitalization
SML	Security market line

1. Introduction

The beta value measures the risk added on to a diversified portfolio, not the total risk of the stock. Betas measure the relative risk of an asset and they should be standardized around one in the CAPM. For an investor, venture capitalists and a manager of a growth firm it's always of interest to know which impact the market risk has on the stock or the firm. One way is to use past stock prices against a market index to get a beta value. The more exposed the firm is to market risk intuitively, the higher is the firms beta. Damodaran (1999) shows an alternative way of estimating the beta value with a bottom-up beta approach. This approach will be used and discussed in this thesis.

1.1. Problem formulation and purpose

The purpose of this thesis is to study the beta risk on Axfood and Volvo vs. the market risk using a bottom-up beta approach and a single CAPM approach. Which beta approach is more preferable and why? The discussion about the CAPM and the bottom-up beta approach will be extensive. Theory of the CAPM will also be discussed.

1.2. Limitations

The focus of the thesis is regarding the risk parameter β. Which β – value is most preferable under different perspectives. Accounting betas and fundamental betas will also be mentioned. As a limitation this thesis will not go into any critique towards the CAPM such as Rolls critique presented in Roll & Ross (1977). The CAPM may not be a realistic model, but it's a good bench mark model for theoretical purposes.

1.3. Outline

The outline of this thesis is as follows: Section 2 presents a brief review of previous research. Section 3 presents the theoretical framework of this thesis. Section 4 presents the methodology and data used in this thesis. The empirical results are presented in section 5 and the conclusions are presented in section 6.

2. Brief review of previous research

Ekern (2006) conduct the study with focus on different mistakes that can be made on applications of the CAPM in valuation of mispriced financial assets and in capital budgeting. Derivations of twelve valuation expression that relates to CAPM methods are presented in Ekern (2006). In disequilibrium IRR based returns differ from market based returns, covariance terms for market based and cost based asset returns differ with market portfolio return, which leads to that beta for the market and beta based on cost is not the same.

Nielsen & Vassalou (2004) studies the instantaneous capital market line. The empirical results conclude that if the intercept and the slope of the ICML are deterministic the slope is stable as opposed to stochastic. Investors will not hedge against changes in means, variances and covariance’s of security returns. Investors will hold two funds, the less risky asset and the logarithmic portfolio. This theory is called two fund separations. An efficient portfolio is consisted of two funds. Investors will place themselves along the ICML and slide up and down, depending on the investor wealth and risk tolerance.

Jeong-Ryeol Kim (2002) examines a univariate beta model that takes the fat-tails of stock returns and common stochastic trends between stock prices into account. The SLCAPM explains the variation of cross-sectional average return. Average returns are correlated with the long-run information that can be captured by the SLCAPM. It corresponds to mean-variance rule, Markowitz portfolio theory.

Damodaran (1999) studies how one can estimating risk parameters. Damodaran presents flaws about regression betas. The paper presents bottom up approach for estimating beta that reflects current business mix and financial leverage of a firm. The beta for a firm is estimated as the weighted average of unlevered betas of the different businesses that the firm operates in, adjusted to reflect both current operating and financial leverage of the firm. The bottom-up approach has the most promise in delivering updated betas for most firms.

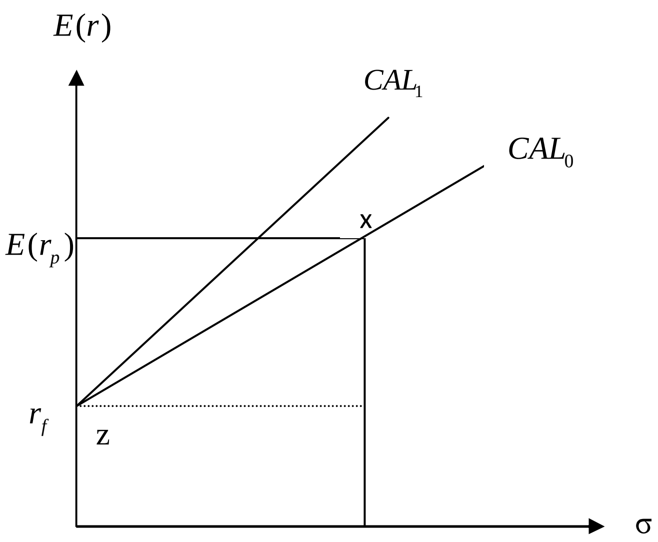
Boardman & Carruthers (1985) examines how each expansion opportunity should be evaluated on its own merits. Expected return and systematic risk should be taking into consideration simultaneously, not separately. CAPM allows strategic planners to compare businesses with different risks. The paper suggests that no gain can be made in efficient market equilibrium. According to them purchasing of businesses should be made if they lie above the SML, and sold if they lie below the market line.

3. Theoretical framework

Sharpe (1964) developed the CAPM in articles with Mossin (1966) and Lintner (1965) among others. In Markowitz (1952) the ground for modern portfolio management was developed. CAPM is predictions concerning equilibrium expected returns on risky assets.

3.1 Optimal complete portfolio

Figure 1: The optimal complete portfolio



Source: Bodie et al. (2005)

In figure 1, the optimal complete portfolio is shown. The X has a standard deviation, $\sigma > 0$, this implies a more risky asset, than Z, that has a standard deviation, $\sigma = 0$, which implies a risk free asset. An individual's risk aversion plays a big role in the choice for the optimal complete portfolio; a more risk averse individual will invest a bigger amount in the risk free asset, as a less risk averse individual might choose a more risky portfolio. Y is the proportion invested in the risky portfolio and 1-Y is the proportion invested in the risk free asset. $E(rc)$, are the expected rate of return of the complete portfolio.

$$E(r_c) = yr_p + (1-y)r_f \tag{1}$$

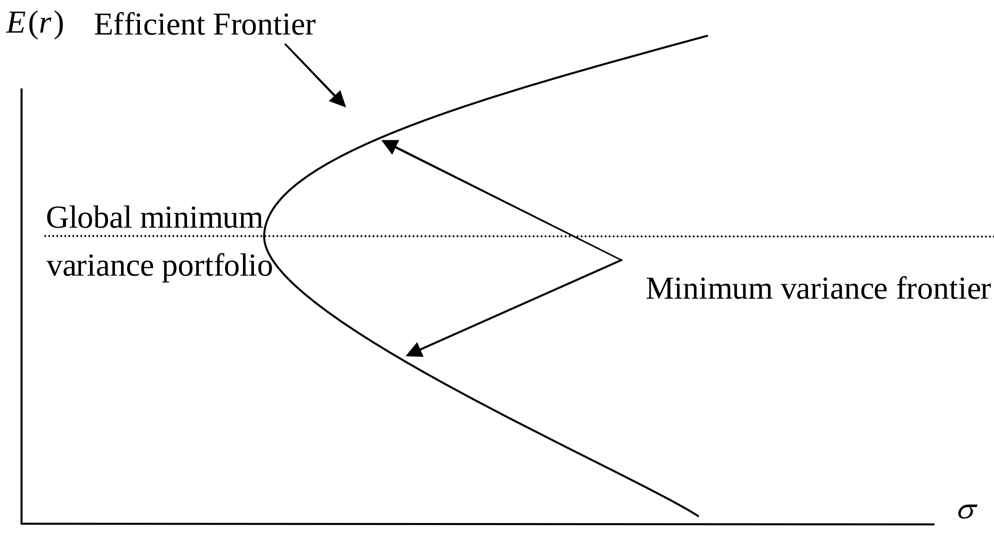
The capital allocation line CAL is an opportunity set of one risk free-asset and a risky asset. The CAL represents all possible optimal investment opportunities between risk free and risky assets. The slope of the CAL is determined by the reward to volatility ratio:

$$S = \frac{E\left(r_p - r_f\right)}{\sigma_p} \tag{2}$$

A steeper CAL means higher expected return for any level of risk; depending on the individual's preferences towards risk. We want to find the risky portfolio with the highest reward-to volatility ratio. Capital market line (CML) is the CAL provided by 1-month T-bills and a broad index of common stocks the market portfolio.

3.2 Markowitz – minimum variance frontier of risky assets

Figure 2: The efficient frontier



Source: Bodie et al. (2005)

The idea behind the Markowitz portfolio selection model is that the efficient frontier of risky assets is that for any risk level we are only interested in that portfolio with the highest expected return.

The portfolios that lie on the efficient frontier from the global minimum variance portfolio and upward are the best risk return combinations, all of those are candidates for the optimal portfolio. See figure 2. This is called the efficient frontier of risky assets. Where you want to position yourself on the efficient frontier depends on your attitude towards risk. On the lower frontier it's a portfolio with the same standard deviation, σ , and a greater expected return positioned directly above, these two portfolios are negatively correlated, $\rho = -1$. So from the global minimum variance portfolio and downwards is inefficient to take a position.

A positive correlation between two assets means that the asset returns move together. The negative covariance means that returns move inversely. The correlation coefficient between two e.g. stocks can take a value between 1 and -1. If the value is 1 the two stocks is said to be perfectly positive correlated which means that they follow each others movements, if the value is -1 it's perfectly negative correlated, the stocks move in opposite directions. For diversification benefits use both assets with positive and negative covariance to offset the risk of the portfolio, the volatility will be reduced if the correlation is low.

The expected return on the portfolio:

$$E\left(r_p\right) = \sum_{i=1}^{n} w_i E\left(r_i\right) \tag{3}$$

The variance of the portfolio:

$$\sigma_p^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} w_i w_j Cov\left(r_i, r_j\right) \tag{4}$$

The standard deviation on the portfolio:

$$\sigma_p = \sqrt{\sigma_p^2} \tag{5}$$

The correlation coefficient:

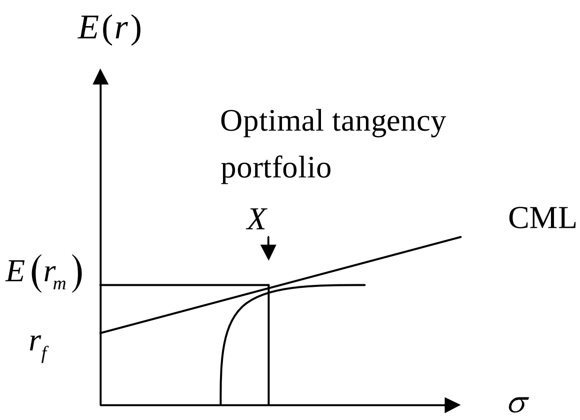
$$\rho_{x,y} = \frac{\text{cov}(x, y)}{\sigma_x \sigma_y} \tag{6}$$

3.3 Assumptions for the basic version of the CAPM

- There are many investors that act as price takers, they act as though security prices are unaffected by their own trades.
- Investors can only invest for one single period. $(t_0 - t_1)$
- All investors can at any time borrow or lend at the risk free rate of interest.
- Investors pay no taxes on returns and no commissions and service charges on trades in securities.
- All investors are rational mean –variance optimizers. They want to invest in that portfolio with the highest expected return. The Markowitz portfolio selection model.
- All investors have homogenous expectations. Given a set of security prices and the risk-free interest rate, all investors use the same E(r) and covariance matrix of security returns to generate the efficient frontier and the unique optimal risky portfolio.

3.4 The efficient frontier and the capital market line

Figure 3: The efficient frontier and the Capital Market Line



Source: Bodie et al. (2005)

In the CAPM world, all investors hold there market portfolio X as there optimal risky market portfolio see figure 3, the only thing that differs is the proportion of money invested in the risky asset and the risk free asset. The optimal risky portfolio X will lie on the efficient frontier and is the tangency portfolio to the CAL. The CML from the risk free rate through the market portfolio X is the best CAL.

The risk premium on the market portfolio is defined by the following formula and takes into account the average degree of risk aversion among individuals

$$E\left(r_m\right)-r_f=\bar{A}\,s_m^2\times 0.01 \quad (7)$$

Where $E\left(r_m\right)$ denotes the expected return on the market portfolio, r_f denotes the risk free rate, σ_m^2 denotes the variance of the market portfolio and $\bar{A}$ denotes the average degree of risk aversion across investors.

The beta measures the extent to which returns on the stock and the market move together, and can be calculated by the following equation:

$$\beta_i=\frac{Cov\left(r_i,r_m\right)}{\sigma_m^2} \quad (8)$$

The assets beta measure the risk added on to a diversified portfolio, the contribution of the asset to the portfolio variance. See figure 5, hence, the SML is valid for both efficient portfolios and individual assets. The SML provides the required rate of return for compensation to the investors risk aversion. Fairly priced assets plot exactly on the SML. The SML can be used as a benchmark to find the fair expected return on risky assets. Beta is a measure of the volatility, or systematic risk of a security or a portfolio in comparison to the market as a whole. A zero beta portfolio has the same expected return as the risk-free rate. The market beta is equal to 1.

The calculation on risk premiums on individual securities can be calculated by the formula below:

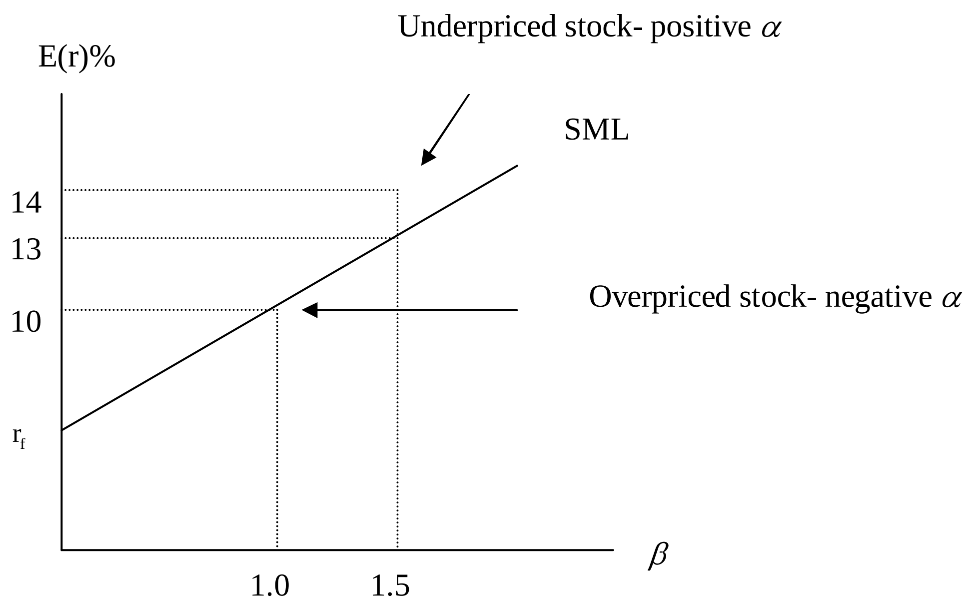
$$E\left(r_i\right)-r_f=\frac{Cov\left(r_i,r_m\right)}{\sigma_m^2}\left[E\left(r_m-r_f\right)\right]=\beta_i\left[E\left(r_m\right)-r_f\right] \quad (9)$$

From the expected return-beta relationship we can draw the (SML) Security market line.

$$E(r_i) = r_f + \beta_i \underbrace{\left(E(r_m) - r_f\right)}_{Riskpremium} \tag{10}$$

3.4.1. The Security Market Line and single stocks

Figure 5: The security market line



Source: Bodie et al. (2005)

3.5 Jensen's measure alpha (α)

One method to measure the performance of managers is to use the risk adjusted performance evaluation Jensen's measure alpha. The risk parameter alpha is the difference between the fair and actual expected return on a stock or a portfolio. When a stock is fairly prices the alpha is equal to zero. Positive alpha means that the stock/portfolio is under priced, negative alpha the opposite over priced. The CAPM states that the expected value of alpha is zero for all securities. Jensen (1968) examined the alphas realized by mutual funds over the period 1945 to 1964 which show that the frequency distribution of these alphas seem to be distributed around zero. The Jensen's measure alpha is defined by the following equation:

$$\alpha_p = r_p - r_f \left[\beta_p \left(r_m - r_f \right) \right] \qquad (11)$$

Where r_p, denotes the expected return on the portfolio, r_f is the risk free rate, β_p is the beta of the portfolio and the expected return on the market denotes, r_m.

3.6 Risk premium on the market portfolio

Equilibrium risk premium on the market portfolio $E(r_m) - r_f$ will be proportional to the average degree of risk aversion across all investors and the risk, volatility, of the market portfolio σ_m^2.

$$y = \frac{E(r_m) - r_f}{0.01 \times A\sigma_m^2} \qquad (12)$$

From this equation we can get the Y which is the proportion of risky assets allocated to the optimal portfolio X. In the basic version of the CAPM risk free investments means borrowing and lending among investors. The borrowing position must be offset by the lending position which means that borrowing and lending across all investors must be zero, so the average position in the risky portfolio is therefore 100%, or $\bar{Y} = 1$, equal to the entire wealth of the economy, all investors hold the market portfolio X. Meaning that, the risk premium on the market portfolio is related to its variance by the average degree of risk aversion. The following equation is used;

$$E(r_m) - r_f = 0.01 \times \bar{A}\sigma_m^2 \qquad (13)$$

3.7 Different types of market indexes

The Capitalization-weighted index, (market value weighted index). S&P 500 is a capitalization-weighted index. Market capitalization is a measure of a company total value.

$$\text{MCAP} = \text{\# of shares outstanding} \times \text{current market price of one share} \qquad (14)$$

$$\text{Weighted average MCAP} = \frac{\text{A company´s MCAP}}{\text{MCAP in the index}} \qquad (15)$$

Price weighted index. The value of the index is calculated by adding prices of each of the stock in the index and dividing them by the total number of stocks. Dow Jones Industrial Average is a price weighted average of 30 significant stocks on the New York Stock Exchange and the NASDAQ. Dow Jones measures the return and excluding the dividends on a portfolio that holds one share of each stock this is a price-weighted average. Stocks with a higher price will then have more impact on the index because they will be given more weight.

3.8 The Beta parameter

Beta is the sensitivity of a firms stock to general market movement. Beta risk can not be diversified away.

The Beta-value has two basic characteristics:

1. Beta measures the risk added on to a diversified portfolio
2. Betas measures the relative risk of an asset and are around one

The beta for an asset can be estimated by a regression. Asset returns against an index that represents the market portfolio.

$$R_j = a + bR_m \qquad (16)$$

Where R_j denotes the return on the stock, R_m denoted the return on the market index and b denotes the beta of the stock.

This beta has the following problems:

- High standard error
- It just reflect the firms business mix over the period of the regression, not the firms current business mix
- It reflects the firms average financial leverage, not the firms current leverage

If $\beta > 1$, the stock is volatile, i.e. aggressive, and if $\beta < 1$ the stock is less volatile, i.e. defensive. A defensive stock is more appropriate for the risk averse investor; it tends to be very stable during volatile phases of the business cycle. In a recession, the defensive stock tends to be fairly stable and not as volatile as a stock with a beta over one. An aggressive stock is more volatile and dependent on the business cycles fluctuation and the overall market performances.

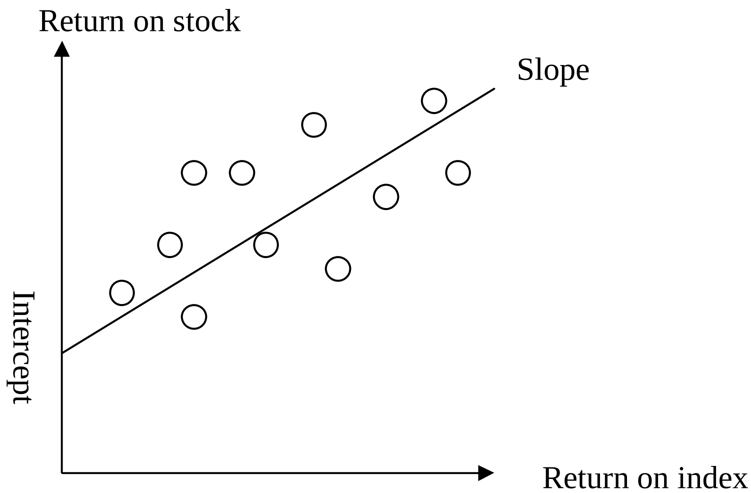
The higher beta a stock have, the more risky is the stock. Beta explains how a one percentage change in the market risk premium (index) will affect the stock.

The linear relationship between the return on individual securities and the overall market is defined by the following equation:

$$R_i = \alpha_i + \beta_i R_{mt} + \varepsilon_i \qquad (17)$$

Figure 6 gives an illustration of the simple linear regression model for stock returns.

Figure 6: The simple linear regression model for stock returns.



Source: Damodaran (1999)

3.8.1 Accounting Betas

Accounting betas can be used as an ex ante risk measure for firms entering into the IPO market and is outlined in Almisher & Kish (2000). The accounting beta is based entirely on financial statements, accounting data. An high accounting beta is a proxy for a high risk firm, the potential investors than expect a higher return as a compensation for the risk undertaken. To estimate the accounting beta, regress the change in a private firm's accounting earnings against changes in earnings for an equity index. The equation looks as is as follows:

$$\Delta \text{ Accounting earnings of private firm } = a + b\Delta \text{ Earnings from index} \quad (18)$$

Where b, denotes the accounting beta for the firm. The unlevered accounting beta is given by using operating earnings, whereas net income is used gets the levered accounting beta.

There is some downside with this approach, private firms has regressions with few observations depending on that they usually measure earnings only once a year. The earnings are often smoothed out which leads to mismeasurement of accounting betas.

3.8.2 Fundamental Beta

The definition for fundamental analysis is the following: the assessment of the value of a share on a company's actual earnings, assets and dividends. Individuals that try to estimate a shares true value based on future returns to the company.[1] The definition for a fundamental beta; the product of a statistical model to predict the fundamental risk of a security using not only price data but also other market related and financial data.[2] Fundamental beta is used for calculate unlisted firm. Fundamental betas make use of observable variables such as debt ratios, earnings growth and variance in earnings. The estimation has large estimation errors, noise and a low r-square.

Beaver et al. (1970) among others suggest that fundamental information and historical beta estimates provide superior predictors of future betas. To give an example assume a regression that includes four variables that is dividend yield on the stock, the standard deviation in percentage change in operating income over T years, book value of D/E ratio, and the market capitalization which measures the market value of equity in millions. This can then be observed in the equation:

$$\beta = \sigma_{0I} + \text{yield} + \frac{D}{E} - \text{market capitalization} \qquad (19)$$

Where σ_{OI} denoted the standard deviation in percentage change in operating income over T years, yield denotes the yield on the stock, $\frac{D}{E}$ denotes the book value of debt/ equity, and market capitalization is calculated by using equation (26).

This approach has problem with noise, the r-square is low and there is large standard errors.

[1] London school of UK/ finance glossary

[2] Trading glossary.com

3.8.3. Bottom up Betas

The bottom-up approach is adjusted to reflect the current operating and financial leverage of the firm. The beta is estimated by the weighted average of the unlevered betas of the different businesses that the firm operates in. There are three conditions that determine a beta of the firm and that is used when estimating the beta of the firm.

1. ***The type of businesses the firm is in.***

   The beta measures the risk of a firm relative to the market index. The more sensitive a firm is to the market conditions the higher is its beta. Examples of firms that are very sensitive to economic conditions is real estate and automobiles, these businesses will have higher betas, than for example food and tobacco that is not so sensitive against market conditions have lower betas.

2. ***The degree of operating leverage in the firm.***

   The degree of operating leverage is defined as the relationship between fixed costs and variable costs. A firm that has high fixed costs relative to variable costs will have higher variability in EBIT earning before interest and tax, which will lead to a high beta. A firm that has high operating leverage will have a high beta. It's difficult for an investor to measure the operating leverage of a firm since fixed and variable costs often are aggregated in income statements, one way of calculating it is:

   $$\text{DOL} = \frac{\text{\% change in operating income}}{\text{\% change in sales}} \qquad (20)$$

   The greater the DOL is the higher is the beta. Higher fixed costs increase the exposure of market risk.

3. ***The firms financial leverage***

   Degree of financial leverage; the higher financial leverage a firm has, the higher beta has the firm. There is a tax benefit for the firm that has leverage. The corporate tax for Sweden 28 percent multiplied by 1/3 because that part is deductible from the interest payments that the company makes to the bondholder's interest payments.

This is the equation used to calculate the levered bottom-up beta:

$$\beta_L = \beta_U \left[1 + (1-t)(M \text{ D/E})\right] \quad (21)$$

Where β_u denotes unlevered bottom-up beta for that specific segment or firm, t denotes the corporate tax rate, M D/E denotes the market value debt equity ratio, equation (25). A firm with high M D/E equity ratio finance its asset with more debt than equity. The levered bottom-up beta is higher than the unlevered bottom-up beta, because more debt makes a firm more risky.

A company that owns several smaller businesses whose products or services are usually very different, with interests spread between varied sectors is called a conglomerate. In the bottom-up beta approach, the equation is as follows to get the weights per sector;

$$\text{Weights sector} = \frac{\text{Operating income}_{\text{sector}}}{\text{Operating income}_{\text{firm}}} \quad (22)$$

To get the unlevered beta in the bottom-up approach, run a simple linear regression to get the unlevered bottom-up beta for each sector, by using the sector indices against a benchmark index. When the unlevered bottom-up beta for each sector is captured, the next step is to calculate the unlevered bottom-up beta for the whole firm, which looks as follows:

$$\text{Unlevered Beta of Firm} = \beta_{\text{sector index}} \times \text{segment weight} + \beta_{\text{sector index}} \times \text{segment weight} \quad (23)$$

Assumptions for the bottom-up beta:

1. Identify in what business or businesses the firm makes assets.

2. Use market debt ratios and unlevered betas for an industry directly with no adjustments. Assume that all firms in a sector have the same operating leverage. Assumption 2, smaller firms tend to have more fixed costs than larger firm.

3. Take a weighted average of the unlevered betas. If the market value is not available, use then the operating income or the revenues as a proxy.

4. Calculate the leverage for the firm. If not the market values or, the target leverage specified by the management of the firm is not available. Use then the industry typical debt ratios.

5. Estimation of the levered beta.

$$\text{Standard error}_{\text{Average Beta}} = \frac{\text{Average standard error}_{\text{Beta estimate}}}{\sqrt{n}} \qquad (24)$$

n= number of firms in the sector/ industry

The first advantage is that we estimate the unlevered betas, by averaging across regression betas, by sector. This reduces the noise in the estimate.

The second advantage, this beta estimates is based upon current weightings for different businesses. Expected changes in business mix can therefore be reflected easily with bottom-up betas.

The third advantage, we can compute the levered beta by the current financial leverage used in the firm. This can estimate the beta more correctly for firms which have changed their debt/ equity ratio in recent periods.

3.8.4 The choice of time interval, return interval and market index affects β

1. ***Choice of market index***

Two of the indices to choose between are a market weighted index or a price weighted index. A market weighted index should yields better estimates than a price weighted index and includes more securities than a price weighted index. A price weighted index is given more weight depending on that the company stock is higher priced than another company.

2. ***Choice of time period***

The advantage with a long time period is that there are more observations in the regression than with a shorter time period. One disadvantage with a long time period is that the firm may have restructured the financial business mix.

3. ***Choice of return interval***

An advantage of using a shorter time interval is that the number of observations increases in the regression. One disadvantage with a short return interval is the non-trading problem, e.g.;

if the last trade on an asset occurs at 2.30 pm and the index is measured at the close of trading at 4.00 pm the beta estimate is affected; the correlation between the asset and the index will be biased downwards.

3.9 Debt to Equity ratio (Leverage ratio)

The debt to equity ratio is a measure of a company's financial leverage. Debt to equity ratio indicates what proportion of equity and debt the company is using to finance its assets. If there is a high debt to equity ratio, it indicates that the company has financed its growth with debt. Debt is liabilities that involve contractual obligations to repay a stated amount and interest over a period. This kind of debts put the firm in default if they are not paid. Bondholders are investors in the firm's debt; they can sue the firm if the firm default on its bond contracts.

In case of company default the bondholders have the first claim to get money and then the stockholders/shareholders. In the bottom-up beta approach, the M D/E is used. That gives the true and current financial leverage of the firm instead of a D/E.

The market debt/equity ratio is calculated by the following formula:

$$\text{M D/E} = \frac{\text{D}}{\text{MCAP}} \tag{25}$$

The market capitalization is calculated by the following formula:

$$\text{MCAP} = \frac{(\text{Number of shares outstanding} \times \text{Stock Course})}{100000} \tag{26}$$

By calculating the M CAP the current value of the firm is captured.

4. Methodology and Data

The data is collected from Ecowin database, 2 April, 2002 until 2 April, 2007, five years daily data. To get the CAPM beta, Affärsvärldens general index and the stock quotes for Axfood, Volvo A and Volvo B has been collected. To get the bottom-up beta, three sector indices, financial service industry index, industrial conglomerate index and the consumer goods index are used. Return and time interval is 5 years daily data.

The formula that has been used to calculate the CAPM beta return looks like following:

$$\text{Return Axfood} = \alpha + \beta_1 \times \text{Return Generalindex}$$

$$\text{Return Volvo A} = \alpha + \beta_2 \times \text{Return Generalindex} \qquad (27)$$

$$\text{Return Volvo B} = \alpha + \beta_3 \times \text{Return Generalindex}$$

Table 1: Beta values from CAPM regression

β_1	~	CAPM β for Axfood
β_2	~	CAPM β for Volvo A
β_3	~	CAPM β for Volvo B

Note: Definitions for the Axfood, Volvo A, Volvo B betas see appendix B.

For the bottom-up beta approach to get the unlevered betas looks as follows:

$$\text{Consumer goods index} = \alpha + \beta_{11} \times \text{Generalindex}$$

$$\text{Financial service index} = \alpha + \beta_{12} \times \text{Generalindex} \qquad (28)$$

$$\text{Industrial conglomerate index} = \alpha + \beta_{13} \times \text{Generalindex}$$

Table 2: Unlevered bottom-up betas[3]

β_{11} ~	Unlevered bottom-up beta for consumer goods
β_{12} ~	Unlevered bottom-up beta for the second sector Volvo Financial Services
β_{13} ~	Unlevered bottom-up beta for the first sector Volvo industrialconglomerate

Note: Definitions for the different unlevered bottom-up betas see appendix A.

The following equations define how to calculate the Mean.

Arithmetic mean:

$$\bar{X} = \frac{x_1 + x_2 + ...x_n}{n} = \frac{\sum x}{n} \qquad (29)$$

The Arithmetic mean is preferable when we want to predict future performance. The arithmetic is then the interest because it's an unbiased estimate of expected return.

Geometric Average:

$$\sqrt[t]{n-1} \qquad (30)$$

The geometric average is an excellent measure of stock returns on past performance. Because it can show us how much we need to earn to match the actual performance over ex-post investment period.

[3] Following a similar approach as in Damodaran (1999) for estimation of the unlevered beta in the bottom-up beta approach, the level of leverage for a specific sector is not taken into consideration. Hence, an unlevered beta.

4.1 Regression

The standard procedure for measure the risk of the stock is to use the linear regression.

$$R_j = a + bR_m \qquad (31)$$

R_j = return on the stock
R_m = return on the market
a= intercept
b= the slope of the regression

The equation for the simple linear regression is defined in the following equation:

$$Yi = \beta_0 + \beta_1 X_i + \varepsilon_i \qquad (32)$$

$\beta_0 = is$ the intercept
$\beta_1 = is$ the slope
ε_i = is a random error term

The interpretation of the result should be ”If the right hand side (explanatory variable) variable moves 1 percent, the left hand side (dependent variable)variable will move beta percent. Note it is always that the explanatory variable (on the right hand side) that decides the variable on the left hand side (dependent variable).

In the first step calculation from each stock return is continuously compounded.

$$R_t = \ln(P_t) - \ln(P_{t-1}) \qquad (33)$$

P_t = The price today
P_{t-1} = The price previous day

Standard deviation is a measure for risk; larger standard deviation indicates that the stock is more volatile. Less standard deviation indicates a more stable stock.

5. Empirical results

In this section, the empirical results from the different regressions are presented and also calculations for the bottom-up beta.

5.1 Axfood

Axfood is treated as one whole sector, using consumer goods index. Table 1 below presents the components/figures needed to calculate the bottom-up beta approach.

Table 1: Axfood from 2002-2006

Axfood	**2006**	**2005**	**2004**	**2003**	**2002**
Shares outstanding	53 162 625	54 583 928	54 573 109	54 336 100	54 459 993
Stock price 29/12 (SEK)	283	-	-	-	-
Stock price 30/12 (SEK)	-	221	225	166.5	162
Market CAP, million SEK	150 450 229	1 206 304 809	122 789 495	904 696 065	8 822 518 866
Operating income, million SEK	1204	1040	1126	1034	1023
Debt, million SEK	3188	3449	3781	3386	3522
Equity, million SEK	2420	2825	2644	2127	1693
D/E ratio	1.32	1.22	1.43	1.59	2.08
Market Debt/Equity	0.21	0.29	0.31	0.37	0.4

Source: EcoWin, Axfood annual report (2006) and calculations by the author.

The first step is to get the unlevered bottom-up beta equation (28), by a regression on the sector index which is the consumer goods index against the benchmark the general index. See appendix A. By using equation (21) the levered bottom-up beta for each year from 2002 to 2006 can be estimated. The results from the regression for the levered bottom-up beta can be found in table 2.

Table 2: Levered Bottom-up β for Axfood.

Axfood	2006	2005	2004	2003	2002
Levered bottom-up β	0.87	0.92	0.94	0.97	0.99

Source: Axfood annual report (2006) and calculations by the author.
Note: The calculations for the Bottom-up beta can be found in the appendix C.

As can be seen in table 2, the levered bottom-up beta for 2006 is 0.87.

Table 3: Beta values for Axfood.

Axfood	Beta value
Unlevered bottom-β_{11} consumer goods	0.73
Levered bottom-up β	0.87
β_1 CAPM return	0.29

Source: Axfood annual report (2006) and calculation by the author.
Note: The calculations for the three different β-values can be found in the appendix A, B and C.

Table 3, shows three different beta values, the CAPM beta is done by a regression, equation (27). The return on the Axfood stock will either increase or decrease with 0.29 percent if the market portfolio in this case the General index moves with 1 percent up or down.

Using equation (21) the levered bottom-up beta of the firm is calculated and gives a bottom up-beta that is 0.87. This bottom up beta for Axfood reflects the firm's current business mix, which shows that the stock has a greater impact on market movements than the CAPM beta and the unlevered bottom-up beta, which are 0.73. If the market moves 1 percent the consumer goods index moves with 0.87 percent, according to the levered bottom-up beta, Axfood is more dependent on the economic market conditions than the CAPM beta suggests. All betas are below 1, so Axfood is a defensive stock.

5.2 Volvo

Volvo is a diversified company, conglomerate. Volvo has 6 different segments, Trucks, Busses, Construction Equipment, Volvo Penta and Volvo Aero, financial services. One sector is Renault trucks, Mack trucks and Volvo trucks. I have divided the six different segments into two different sectors. The first step in the bottom-up approach is to run a simple linear regression to get the unlevered beta for each sector, by using the sector indices against a benchmark in this case, Affärsvärlden General index.

This thesis has divided Volvo into two sectors. I have run a simple linear regression, the industrial conglomerate index against the general index, for the first sector which includes trucks, busses, construction equipment, aero and penta. The second sector is financial services so a financial service index is used against the general index. See equation (28).

Table 4: Volvos six segments weighted by operating income (equation 22)

Segment	Operating income/segment	Weights/sector in percent	Weignts used for the calculations in this table
Volvo Trucks	166 306	66.2	0.661972392
Volvo Buses	16856	6.71	0.067094432
Volvo Construction Equipment	40564	16.15	0.161462894
Volvo Aero	10485	4.17	0.041734998
Volvo Penta	8048	3.2	0.032034646
Volvo Financial Services	8969	3.57	0.035700638
Total	**251 228**	**100**	**1**

Source: Volvo annual report (2006) and calculations by the author.

The calculation for the DOL equation (20) for Volvo can be found in appendix E.

Industrial conglomerate index gives an unlevered bottom-up beta of 0.99 and the financial service industry index unlevered bottom-up beta is 1.09, using equation (28). To get the unlevered bottom-up beta for Volvo including all sectors, in this case two sectors, equation (23) is used and calculated on the next page.

$$\beta u_{volvo} = 0.99(0.9643) + 1.09(0.0357)$$
$$\beta u_{volvo} = 0.99357 \Rightarrow \beta u_{volvo} \approx 0.99$$

The unlevered bottom-up beta is 0.99 for Volvo including the two sectors, financial service and industrial conglomerate. For further information about the regression for the two sectors unlevered bottom-up betas, see appendix A.

Table 5: M CAP for Volvo equation (26)

Volvo stocks	Shares outstanding	Stock price 2006-12-29 (SEK)	Market CAP
Volvo A	135 520 326	93.52	1 267 386 089
Volvo B	290 163 718	90.67	2 630 914 431
Total	**425 684 044**		**3 898 300 520**

Source: Volvo annual report (2006) and calculations by the author.

The long term debt for Volvo is 45 457 Mkr and the short term debt is 28 247 Mkr[4]. Eq (25):

$$\text{M D/E} = \frac{45\ 457}{389\ 830\ 052}$$

$$\text{M D/E} = 0.1166$$

M D/E ratio for Volvo is 11.66 percent, which means that 11.66 percent of Volvos assets are financed by debt.

To get the levered bottom-up beta, equation (21) is used.

$$\beta l_{volvo} = 0.99(1 + (1 - 0.28 \times 1/3)(0.1166))$$
$$\beta l_{volvo} = 1.09466016$$
$$\beta l_{volvo} \approx 1.09$$

The levered bottom-up beta for Volvo is 1.09.

[4] Volvo yearly report 2006 page.88

Table 6: The Bottom-up β values for Volvo

Volvo	Unlevered Bottom-up β	Levered Bottom-up β
Two sector	0.99	1.09

Source: Volvo annual report (2006) and calculations by the author.
Note: The calculations for the unlevered bottom-up β can be found in the appendix A.

If the D/E is used instead of the M D/E, the debt is 45 457 Mkr, and the book value of equity is 87 188 Mkr.[5]

$$D/E = \frac{45\ 457}{87\ 188}$$

$$D/E = 0.5213676194$$
$$D/E = 0.52$$

This indicates that Volvo has financed its assets with 52 percent debt. So the levered bottom-up beta for Volvo should be more dependent on market conditions and have a high beta.

To calculate the levered bottom-up beta equation (21) is used, with a D/E, instead of an M D/E.

$$\beta_{lvolvo} = 0.99((1+(1-0.28\times 1/3)(0.5213))$$
$$\beta_{lvolvo} = 1.45791888$$
$$\beta_{lvolvo} \approx 1.46$$

From the calculation above, the levered bottom-up beta for Volvo is 1.46 with a D/E instead of an M D/E, i.e. if there is a 1 percent change in the general index, Volvo stock moves either up or down 1.46 percent. One reason for the high beta value can be that the D/E is much higher than the M D/E which indicates that the company has more debt, becomes more risky.

[5] Volvo yearly report 2006 page. 88

Table 7: The CAPM β, for Axfood, Volvo A and Volvo B. Equation (27)

Stocks	**CAPM β**
β_1	0.29
β_2	0.54
β_3	0.52

Source: EcoWin 020402-020407 and calculations by the author.

Note: The calculations for the three different CAPM β-values can be found in the appendix B.

Table 8: The unlevered bottom-up beta for the three sectors. Equation (28)

Sector	**Unl bottom-up β**
β_{11}	0.73
β_{12}	1.09
β_{13}	0.99

Source: EcoWin 020402-020407 and calculations by the author.

Note: The calculations for the three different sector β-values can be found in appendix A.

6. Conclusions

The empirical results for Axfood by using a bottom-up beta approach indicates that the company is more dependent on the market movements than the CAPM beta. The levered bottom-up beta is 0.87 and the CAPM beta is 0.29. One might thought that the consumer goods index (Axfood) should yield a lower beta in the bottom-up approach it should not be so dependent on market movements.

For Volvo the CAPM beta 0, 54/0, 52 shows that the stock is defensive $\beta < 1$. The industrial conglomerate levered bottom-up beta is 1.09 indicates that Volvo which is an industrial conglomerate moves almost as same as the market. With a D/E ratio Volvo moves 1.46 percent up or down when the general index moves 1 percent up or down. But the most current and updated measure is the M D/E not the D/E ratio.

The beta values are different depending on if we use the CAPM or the bottom-up beta approach. The purpose of this thesis is to test two Swedish companies on the large cap of Stockholm stock exchange. Using a bottom-up beta approach when calculating the risk for a firm has an advantage because it takes into account the business mix of the firm and it can facilitate specific investment decisions. Bottom-up approach employs financial leverage, operating leverage of the firm, which sector it operates in, and no past stock prices is needed only the current stock price. It gives a truer reflection on the firms risk profile than a CAPM beta. The CAPM beta takes only into account the past stock prices into consideration not the accurate risk the firm is in. By using an M D/E ratio in the bottom-up beta approach, the current M CAP is captured which shows a more accurate picture on how much debt the firm has relative to its market value. It’s more preferable to use the M D/E ratio than a D/E ratio it gives a more updated number and the M CAP is also captured.

The regression CAPM beta is good to calculate the risk for an average investor who holds one stock. The bottom-up beta is best suited to estimate the beta of a conglomerate diversified in different braches. In the bottom-up beta approach you use the different industry averages to measure the risk that the firm is in. But the bottom-up beta approach is also a good estimate for an investor that holds a portfolio.

References

Almisher, M. and Kish, R. J. (2000) Accounting betas-an Ex anti proxy for risk within the IPO market, *Journal of financial and strategic decisions*, **13(3).**

Beaver, W., Kettler, P., Scholes, M., (1970), The Association Between Market Determined and Accounting Determined Risk Measures, *The Accounting Review*, **45**, 645-682.

Bodie, Z., Kane, A., Marcus, A. J. (2005) *Investments, 6th edition*, McGraw-Hill, New York.

Boardman, A. E. and Carruthers N. E., 1985, A Note on the Use of the CAPM as a Strategic Planning Tool. *Management Science*, **31,** 1589-1592

Ekern, S., A Dozen Consistent CAPM-Related Valuation Models -So Why Use an Incorrect One? (2006) *Discussion paper 6/2006* Department of Finance and Management Science Norwegian School of Economics and Business administration.

EcoWin database [2007-02-17]

Jensen, M. C. (1968) The performance of Mutual Funds in the Period 1945-1964, *Journal of Finance*, **23**.

Jeong-Ryeol, K. (2002) The stable long-run CAPM and the cross-section of expected returns, *Discussion paper 05/02* Economic Research Centre of the Deutsche Bundesbank.

Lintner, J. (1965) The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets, *The review of economics and statistics*, **47**, 13-37.

Mossin, J. (1966) Equilibrium in capital asset market, *Econometrica*, **34(4)**, 768-783.

Nielsen, T. L. and Vassal M. (2006) *Economic Theory* **28**, 651-664.

Roll, R. (1977) A critique of the asset pricing theory's Tests: Part 1: On past and potential testability of the theory, *Journal of Financial Economics*, **4**.

Sharpe, W. F. (1964) Capital Asset Prices: A theory of market equilibrium under conditions of risk, *The Journal of Finance*, **3**, 425-442.

Internet pages:

Papers:

Beneda, L. N. (2003) Estimating cost of capital using bottom-up Betas, *The CPA journal*, University of North Dakota.
Available at: http://www.nysscpa.org/cpajournal/2003/0503/dept/d056603.htm [2007-08-26]

Damodaran, A., (1999) Estimating Risk Parameters, Stern School of Business, 44 West Forth Street, New York, NY 10012, USA
Available at:
http://pages.stern.nuy.edu/~adamodar/New_Home_Page/papers.html [2007-08-26]

Damodaran, A. Estimating the cost of equity for a private company.
Available at:
http://pages.stern.nyu.edu/~adamodar/New_Home_Page/valquestions/totalbeta.htm
[2007-08-26]

Damodaran, A. Estimating discount rates DCF valuation.
Available at:
http://pages.stern.nyu.edu/~adamodar/ [2007-08-26]

Yearly reports:

Volvo (2006)
Available at:
http://www.volvo.com/group/sweden/sv-se/investors/financial_reports/annual_reports/
[2007-08-26]

Axfood (2006)
Available at:
http://www.axfood.se/oliver_upload/upl13061-Axfood.pdf [2007-08-26]

Glossary:

http://www.trading-glossary.com/f0367.asp [2007-08-26]

http://www.lse.co.uk/financeglossary.asp?searchTerm=fundamental&iArticleID=1346&definition=fundamental_analysis [2007-08-26]

Appendix A

Three sector index regression against the general index to get the unlevered β for the bottom-up approach

Consumer goods index	Coefficients	Std.Errors	t	Sig.	95 % Confidence interval		R-squared	Adjusted R-squared	N
					Lower bound	Upper bound			
Generalindex	0.7369409	0.0172992	42.85	0.000	0.703198	0.7706838	0.5982	0.5979	1235
(Constant)	0.0002464	0.0002083	1.18	0.237	-0.0001623	0.0006551			
Consumer goods index = 0.0002464 + 0.7369409*Generalindex									

Finacial service industry index	Coefficients	Std.Errors	t	Sig.	95 % Confidence interval		R-squared	Adjusted R-squared	N
					Lower bound	Upper bound			
Generalindex	1.090096	0.0338388	32.21	0.000	1.023708	1.156484	0.4570	0.4566	1235
(Constant)	-2.37e-06	0.0004098	-0.01	0.995	-0.0008064	0.0008017			
Finacial service industry index = -2.37e-06 + 1.090096*Generalindex									

Industrial conglomerate index	Coefficients	Std.Errors	t	Sig.	95 % Confidence interval		R-squared	Adjusted R-squared	N
					Lower bound	Upper bound			
Generalindex	0.9976936	0.0325453	30.66	0.000	0.9338434	1.0615440	0.4325	0.4321	1235
(Constant)	0.0003333	0.0003942	0.85	0.398	-0.000440	0.0011067			
Industrial conglomerate index = 0.0003333 + 0.9976936*Generalindex									

Appendix B

Three regressions against the benchmark general index to calculate the CAPM β

Axfood	Coefficients	Std.Errors	t	Sig.	95 % Confidence interval		R-squared	Adjusted R-squared	N
					Lower bound	Upper bound			
Generalindex	0.2986771	0.0338132	7.70	0.000	0.2225311	0.3748231	0.0451	0.0443	1257
(Constant)	0.0004032	0.0005108	0.79	0.430	-0.000559	0.0014053			
Return on Axfood = 0.0004032 + 0.2086771*Return on Generalindex									

Volvo A	Coefficients	Std.Errors	t	Sig.	95 % Confidence interval		R-squared	Adjusted R-squared	N
					Lower bound	Upper bound			
Generalindex	0.5448718	0.0370358	14.71	0.000	0.4722129	0.6175308	0.1471	0.1464	1257
(Constant)	0.0007327	0.0004874	1.50	0.133	-0.0002235	0.0016890			
Return on Volvo A = 0.0007327 + 0.5448718*Return on Generalindex									

Volvo B	Coefficients	Std.Errors	t	Sig.	95 % Confidence interval		R-squared	Adjusted R-squared	N
					Lower bound	Upper bound			
Generalindex	0.5264149	0.0351346	14.98	0.000	0.4574858	0.5953440	0.1517	0.1511	1257
(Constant)	0.0006931	0.00004624	1.50	0.134	-0.0002141	0.0016002			
Return on Volvo B = 0.0006931 + 0.5264149*Return on Generalindex									

Appendix C

Calculations of the levered Bottom-up Beta for Axfood (Consumer goods index)

Year	Bottom-up Beta for Axfood
2006	$\beta l_{Axfood} = 0.73\left(1+\left(1-0.28\times 1/3\right)\left(0.21\right)\right) \Rightarrow$ $\beta l_{Axfood} = 0.868992$
2005	$\beta l_{Axfood} = 0.73\left(1+\left(1-0.28\times 1/3\right)\left(0.29\right)\right) \Rightarrow$ $\beta l_{Axfood} = 0.92194$
2004	$\beta l_{Axfood} = 0.73\left(1+\left(1-0.28\times 1/3\right)\left(0.31\right)\right) \Rightarrow$ $\beta l_{Axfood} = 0.9351$
2003	$\beta l_{Axfood} = 0.73\left(1+\left(1-0.28\times 1/3\right)\left(0.37\right)\right) \Rightarrow$ $\beta l_{Axfood} = 0.97$
2002	$\beta l_{Axfood} = 0.73\left(1+\left(1-0.28\times 1/3\right)\left(0.40\right)\right) \Rightarrow$ $\beta l_{Axfood} = 0.99$

Appendix D

Correlation matrix

	Generalindex	**Axfood**	**Volvo A**	**Volvo B**
Generalindex	1	0.2123	0.3835	0.3895
Axfood	0.2123	1	0.1292	0.1370
Volvo A	0.3835	0.1292	1	0.9772
Volvo B	0.3895	0.1370	0.9772	1

Appendix E

The DOL for Volvo (per segment)

Volvo	EBIT	Sales	Degree of operating leverage	Degree of operating leverage in percent
Trucks	12 657	166 306	0.076106695	7.61
Buses	633	16 856	0.037553393	3.76
Construction equipment	3 888	40 564	0.095848536	9.58
Penta	1 002	10 485	0.095565093	9.56
Aero	345	8 048	0.042867793	4.29
Financial services	2 301	8 969	0.25655034	25.66
Total	**20 826**	**251 228**		**60.46**

Appendix F

The stock movements for Axfood, Volvo A, Volvo B and the general index in the time period 020402 - 070402