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Diversifying the Swedish Market Portfolio

How does the composition of the market portfolio proxy affect estimated market betas and cost of equity in the Swedish financial market?

by

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Abstract

According to the Capital Asset Pricing Model (CAPM), the cost of equity estimates are a function of the systematic risk relative to the market portfolio. The market portfolio is a non-observable portfolio containing all investible assets in the world. CAPM is a well-established model in practice. However, most practitioners use an equity-only proxy to calculate the estimated cost of equity. In this thesis, we construct six different market portfolio-proxies that include equities, government bonds, real estate, and corporate bonds, to find how estimates of beta and cost of equity in Swedish financial markets are affected. We run regressions on industry portfolios and find that broader proxies of the market portfolio have substantial effects on estimates. To compare our results from the regressions with investors' investment choices in practice, we investigate new regulations of Swedish public pension funds. Starting 1st of January 2019, the legislation regarding Swedish public pension funds has been changed to adjust to the characteristics of financial markets today. We conclude that the new legislation is in line with our results. Therefore, broader approximations of the market portfolio should not be ruled out by practitioners when estimating market risk and cost of equity.

Keywords: CAPM, Market Portfolio, Cost of Equity, Risk, Swedish Financial Market

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1 Introduction

Capital Asset Pricing Model (CAPM) (Lintner, 1965; Mossin, 1966; Sharpe, 1964) has since its introduction been the foundation for describing the relationship between risk and return in modern financial economics. When estimating the cost of equity of an individual asset or a portfolio, the CAPM is used to capture the risk of the asset relative to the market (French et al., 1987). The market portfolio is a value-weighted portfolio which is supposed to contain all investable assets in the world. French et al. (1987) statistically established that equity pricing tests are robust without adding any other asset classes to the index portfolio, and since then the practitioners in finance have for the most part used equity-only market proxies to estimate the cost of equity. However, even though the cost of equity is not explicitly affected by the market portfolio proxy, it does not mean that the composition of the market portfolio does not have any applicable theoretical significance (Bodie et al., 2017). Hence, broader approximations of the market portfolio should not be ruled out by practitioners when estimating market risk and cost of equity.

In practice, the CAPM is a commonly used method within many areas. In a study conducted by Graham and Harvey, 73.5% out of 392 CFO's who participated in the study stated that they use the CAPM to estimate the cost of equity during daily practice within their firms (Graham & Harvey, 2001). In practice, the model is well established, which is why we find the theoretical grounds interesting to investigate. Without a thorough diversification of the market portfolio or index model used, the model cannot rule out a violation of the expected return-beta relationship for any individual asset. This means that all asset classes must be included for the relationship to hold (Bodie et al., 2017). Therefore, the inclusion of different types of assets in the index portfolio is essential. For example, if the inclusion of other asset types changes the estimates with a large constant, the average cost of equity will remain the same using an equity-only proxy, but the level of cost of equity will be misleading (Kamara & Young, 2018). A broader proxy will, as seen in this paper, affect the estimates and give insights to the development of the future of an asset.

Whether the composition of the market portfolio proxy affects beta and cost of equity estimates or not has previously been up to debate. Kamara & Young (2018) focus mainly on the effect of adding government bonds, using two different models of asset pricing – both the CAPM and Fama-French three-factor model (Kamara & Young, 2018). However, their discussion regarding the results of their findings is not very extended. Also, their reasoning about the effect of adding real estate and corporate debt is not very detailed. This paper addresses the question of the importance of cost of equity when adding more asset classes to the market portfolio proxy. We also discuss the similarities and differences of the estimated cost of equity between the different proxies. The theoretical intuition behind the market portfolio is of importance when pricing assets, since the market portfolio is described as the optimal portfolio for any investor to hold.

To see the composition of portfolios in practice, we investigate Swedish public pension funds' portfolios and compare them with our estimates of market risk and cost of equity. Over the last years, the Swedish public pension funds have increased their capital allocation in alternative assets, e.g., real estate. Though, at the same time, the equity and fixed income parts of the portfolios have been reduced. We analyze the new legislation which got legal power 1st of January 2019. The new laws concern the first-, second-, third- and fourth AP fund. We compare if their latest reallocations are in line with our results and the composition of our market portfolio proxies. The risk exposure of the public pension funds is limited and regulated by Swedish law. The risk profile must be long-term, and all assets must be liquid. Before 2019, a minimum of 30% of the portfolio should be invested in fixed income securities with low credit risk. In contrast, the new regulations allow a minimum of 20% to be allocated in fixed income securities. Only 5% has been allowed to be allocated in assets that are not publicly traded, and therefore, not as liquid as publicly traded assets. The changed legislation allows a maximum of 40% of the portfolio to be invested in alternative assets, including real estate (Sveriges Riksdag, 2018).

The aim of this thesis is subsequently to investigate how the estimated betas and cost of equity differ, depending on the composition of the market portfolio proxy. The accuracy of these numbers is of importance because of the widespread application of the theory. It also gives insights on how to view beta and cost of equity in a broader perspective, which reflects more asset classes. When an investor chooses his or her asset allocation, it is of interest to see the return-risk level relative to alternative investments. Moreover, the research question we aim to answer is: *How does the composition of the market portfolio affect the estimated market betas and cost of equity in the Swedish financial market?*

The remaining part of this thesis has the following outline: First, we review previous research within this area and then present our theoretical framework. Secondly, we go through the data and then the empirical design. Finally, we present our results and comment on them in our conclusion. After that follows references and appendices containing our data statistics.

2 Literature Review

Kamara & Young (2018) investigates the effects of different compositions of the market portfolio. The estimated market portfolio is used as a proxy of "the whole economy" when calculating the estimated cost of equity through various asset pricing tests. Even though it is supposed to be an estimation of the whole economy, the majority of users tend to take the easy way out by just using equity indices for their market. The main focus within Kamara & Young (2018) address the question of what happens with the Capital Asset Pricing Model (CAPM) and an extended version called Fama French 3-factor Model (FF3M), when diversifying the market portfolio by including, e.g., government bonds, real estate and corporate debt in the American financial market.

There are much available literature discussing and researching around the topic of estimating of cost of equity. Some of those mentioned in Kamara & Young's paper are, for example, Fama & French (1997), Ferson & Locke (1998) and Pastor & Stambaugh (1999). All of these three are focused on finding how the estimates of the cost of equity are related to asset pricing model estimation (Kamara & Young p.913, 2018).

In both Fama & French (1997) and Pastor & Stambaugh (1999), a value-weighted portfolio of equities listed at the three major US stock markets is used as the market portfolio. They both find that there is uncertainty regarding firms' cost of equity, primarily because of the uncertainty about beta estimates (Kamara & Young p.913, 2018).

Ferson & Locke (1998) finds through simulation experiments that the errors in estimating the market risk premium (i.e., market portfolio minus the risk-free rate (R_m - R_f)) are much more important than errors in estimating the betas (Kamara & Young p.913, 2018). These previous research results lead the authors onto their niche of research, finding out how much the estimates vary when changing the composition of the market portfolio (Kamara & Young p.913, 2018).

As the research method is strictly empirical, much data is covered. The most commonly used market portfolio, which in this case also is used as the standard approach in the comparison, consists of a value-weighted, equity-only portfolio with data drawn from the University of Chicago's Center for Research in Security Prices (CRSP). The equities within that portfolio are all listed on the New York Stock Exchange, the American Exchange, and on NASDAQ (Kamara & Young p.914, 2018). The risk-free rate is set by the authors as the monthly return on 30-day US Treasury bills (Kamara & Young p.914, 2018). The data used in the first diversified market portfolio, where treasury securities are added, is a value-weighted index of government bond returns constructed by the authors. The index is constructed by using the monthly returns on all treasury securities with a maturity greater than or equal to one year (Kamara & Young p.914, 2018). Their sample period ranges from January 1942 to December 2016 as this is the historical range provided by CRSP.

When calculating the weights of Treasury securities and equity within the first diversified portfolio, one-month lagged total market values are used for both the US equity market and the authors constructed treasury index. Regarding the data used in observations of the FF3M, data for the SMB (small minus big) and HML (high minus low) factors are drawn from the official website of Ken French (French, 2018; Kamara & Young p.914, 2018).

In the fifth section of the paper, Kamara & Young briefly investigates what happens when adding corporate debt, real estate, and a global market portfolio as a proxy for the market portfolio. The data used for these experiments are collected from several different sources. Monthly returns on long-term US corporate bonds from Ibbotson et al.'s research in 2017. Annual market values of outstanding US corporate debt from the Securities Industry and Financial Markets Association. Monthly returns and annual real estate values from the St. Louis Federal Reserve. The proxy for their globally invested market portfolio is the multi-asset market portfolio of Doeswijk, Lam, and Swinkels (Kamara & Young p.914, 2018).

2.1 The Effects on Estimated CAPM Betas

The main tool that Kamara & Young (2018) uses to study the sensitivity of CAPM equity betas to the composition of the market portfolio proxy are two different regressions:

(1.) $$R_{i,t} = a_i + \beta_i R_{m,t} + e_{i,t}$$

(2.) $$R_{i,t} = \tilde{a}_i + \tilde{\beta}_i \tilde{R}_{m,t} + \tilde{e}_{i,t}$$

Interpreting the constituents of the first regression, β_i is the beta of portfolio *i* when using the equity-only market portfolio, hence $R_{m,t}$ is the monthly returns at time *t* of the US equity-only market portfolio in excess of the risk-free rate. In the second regression, $\tilde{\beta}_i$ is the beta of portfolio *i* when using the diversified market portfolio, and therefore $\tilde{R}_{m,t}$ is the monthly returns at time *t* of the diversified value-weighted market portfolio in excess of the risk-free rate. The diversified market portfolio consists of US equities and Treasury securities that the authors construct themselves (Kamara & Young p.915, 2018).

When running these regressions for the 30 industry portfolios, the authors find that there is a remarkable effect of the market portfolio composition on the industry equity betas. It is shown that in every industry, the diversified market portfolio generates a substantially higher beta than the equity-only market portfolio. The mean of the increase in betas is 0.65, and the percentage change of the mean 64.77% (Kamara & Young p.915, 2018). The mean beta increases from 1.02 to 1.67 when using the diversified market portfolio, and the median beta increases from 1.05 to 1.74 (Kamara & Young p.915, 2018). The conclusion drawn from this by the authors is that the composition of the market portfolio, in this case, increases each estimated beta significantly (Kamara & Young p.918, 2018).

3 Theoretical Framework

Modern financial economics was first introduced by Sharpe (1964), Lintner (1965) and Mossin (1966) as they developed the Capital Asset Pricing Model (CAPM). The model aims to describe the relationship between an asset's excess return and the (systematic) market risk. The excess return, or risk premium, is the expected return on an asset over and above the risk-free rate. The model has been subject for criticism throughout the years, most famously by Ross (1976) who questions the empirical grounds of the linear relationship between expected return and risk, which is an essential assumption the CAPM is based upon (Ross, 1976). Even though the theory has been debated, it is one of the most commonly used theories in finance.

3.1 Introduction to CAPM

In the CAPM, some underlying assumptions are made about the individual's preferences: an agent is risk averse, prefers more to less, and all investors are rational (Markowitz, 1952). The theory also describes the market: the securities are traded on public exchanges that are assumed to be competitive and effective. An investor can borrow money and lend at a risk-free rate and can take both long and short positions. Also, we assume no taxes and no transaction costs (Bodie et al., 2017).

In CAPM an asset's risk is given by the standard deviation of the excess return. In CAPM, there are two types of risks – non-systematic or firm-specific risk, and systematic risk. The firm-specific risk is assumed to be reduced by diversification of the portfolio. The reduced risk is achieved by investing in multiple different assets. As the number of different securities included in a portfolio increase, the firm-specific components of the total risk tend to cancel out due to the diversification effect. The lower the correlation between the included assets, the more effective is the diversification (Bodie et al., 2017). That is because the expected returns of the nonsystematic components of the individual securities are assumed to be uncorrelated. Non-systematic risk should not be priced by the market (Sharpe, 1964).

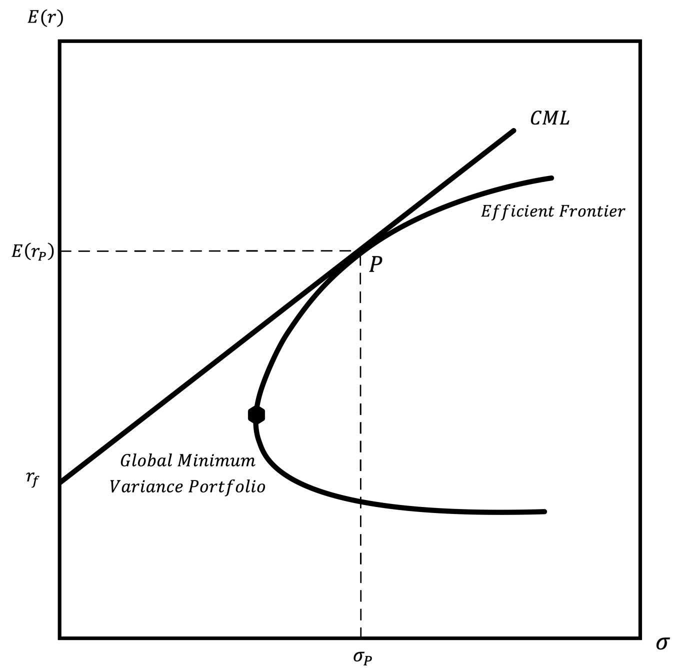
The systematic risk is described as the relative sensitivity, or beta (β), of the individual asset and the market. Securities with high betas have a relatively high sensitivity to market risk compared to securities with low betas and will, therefore, have higher risk premiums to compensate. By definition, the market index portfolio's beta is equal to one ($\beta = 1$). If the investor's portfolio has a higher sensitivity to the market than the average security, or put differently, has more significant "swings" than the market on average, the portfolio-beta will be higher than one, $\beta > 1$. Regardless of how well diversified the investor's portfolio is, the systematic part of the portfolio's total risk will remain because of the exposure to the market (Bodie et al., 2017). The beta of a portfolio, β_p, is calculated with the following equation:

$$\text{(3.)} \qquad \frac{Cov(r_p, r_i)}{Var(r_i)} = \beta_p$$

Where the covariance, $Cov(r_i, r_n)$, of the portfolio returns, r_p, and the return of the market index portfolio, r_i, is divided by the variance, $Var(r_i)$, of the market index portfolio, i.

When an investor chooses to allocate into different assets, both risk-free and risky assets, he or she will choose the portfolio that offers the highest expected return per unit of risk. Alternatively, for any given risk level, the investor only invests in the portfolio with the highest expected return. This means that all investors are assumed to be risk averse (Markowitz, 1952). In order to be able to choose the portfolio with the lowest level of risk, the investor must determine the risk-return opportunities that are available from the set of risky assets. The portfolios that are possible to the investor form the minimum-variance frontier of risky assets. That is, the lowest variance (or risk) that can be obtained given the expected return of each portfolio. The part of the graph that lays above the global minimum-variance portfolio is called the efficient frontier of risky assets. For any portfolio lower than the global minimum-variance portfolio, there exists a portfolio with the same standard deviation but with a higher expected return that is situated on the efficient frontier. One tangent to the efficient frontier combines the optimal risky assets and risk-free assets and is called the Capital Market Line (CML), see Figure 1, p.9 (Bodie et al., 2017).

Figure 1: Capital Market Line (CML)



Source: Figure reprinted from Bodie et al., (2017)

3.2 The Market Portfolio

CAPM aims to answer what would happen if all investors share the same inputs, consisting of all investable assets in the world, to draw the efficient frontiers of risky assets (the same possible portfolios). In light of the earlier assumptions made, their respective efficient frontiers will be identical. Therefore, facing the same risk-free rate, they would all pick the same tangent to the efficient frontier that combines the risk-free assets in the portfolio with risky assets. This is the CML, which results in the same optimal portfolio. All investors will, therefore, choose the same weights of risky and risk-free assets. This portfolio is called the market portfolio and is a value-weighted portfolio that consists of all investable assets the universe – both risk-free and the market. This means that if all portfolios are aggregated so that all long and all short positions are canceled out, the value of the market portfolio will be equal to the entire wealth of the world's economy. Because of the market portfolio's attributes, this is the portfolio all investors aim to hold (Bodie et al., 2017).

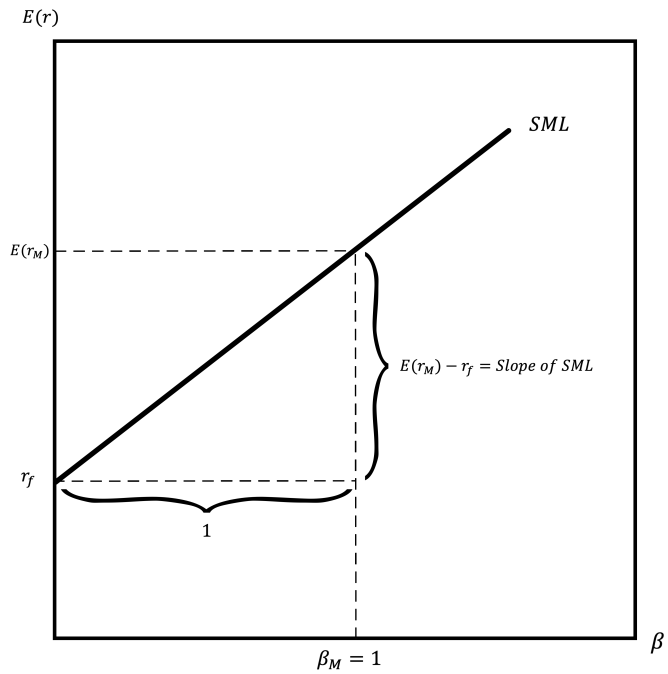
Another way to interpret a portfolio's beta is to view it as the contribution of that individual portfolio contribution to the market portfolio variance, and therefore one could also assume that the risk premium is a function of beta. Furthermore, the CAPM states that an asset's risk premium is directionally proportional to the asset's beta and the risk premium of the market portfolio. With this information, we arrive at the following expression:

$$E(r_p) = r_f + \beta_p\big(E(r_m) - r_f\big) \quad (4.)$$

Where the left-hand side of the expression is the expected return of the portfolio, r_f is the risk-free rate, β_p is the portfolio beta, and $(r_m - r_f)$ is the risk premium of the whole market. Figure 2 shows the risk-reward relationship, the Security Market Line (SML), where the expected return is a function of beta. This graph shows the expected return at any given level of market risk. The slope of the security market line is the market risk premium. The intercept is called the alpha (α) and is equal to the risk-free rate for the SML. This means, by definition, that when α= 0, the portfolio will "only" return the risk-free rate plus the market excess return. According to the CAPM, the market is effective, and therefore, all securities will be situated on the SML at market equilibrium. This means that if an asset is underpriced, and has an alpha higher than the SML, investors will bid up the price until the expected return declines. Similarly, if an asset is overpriced and has a lower alpha, the price will be driven down, and the expected return will go up.

The rebalancing of the portfolio will continue until the until all alphas are driven to zero. In this scenario, to eliminate the firm-specific risk, all investors prefer to hold a portfolio that is as diversified as possible. Note that under CAPM an efficient market is assumed, which is an important parameter here – without that assumption the mechanisms of the market will not adjust the mispricing, and the alphas will not be driven to zero. This is called the efficient market hypothesis and implies that all asset prices reflect all available information.

Figure 2: Security Market Line (SML)



Source: Figure reprinted from Bodie et al., (2017)

With the market portfolio having a beta value equal to one, it is easy to get the expected return of the market portfolio. As previously stated, risk-reward is assumed to be a linear relationship, and therefore we can observe that portfolios with $\beta > 1$ have a higher expected return, and portfolios with $\beta < 1$ have a lower expected return than the market portfolio. Hence, the expected return of the market portfolio can be interpreted as what the market on average returns. The only reason an individual stock or portfolio would return anything above the risk-free-rate is that the asset imposes a systematic market risk for which the investor must be compensated for (Bodie et al., 2017).

The CAPM is an elegant model that presents the risk-reward relationship in a relatively easy way, describing it as a linear relationship. However, in reality, investors create risky portfolios that differ from the market portfolio (Malkiel, 1995). One reason for investors trying to "beat the market" and create a portfolio that over time, outperforms the market portfolio, is that investors use different input lists when forming their optimal portfolio. Recall one of the underlying assumptions of the CAPM is that all investors in the capital markets use the same input list, which is all investable assets in the world (Bodie et al., 2017). The true market portfolio is impossible to observe, and therefore, investors must use approximations when estimating the cost of equity. The fact that the market portfolio cannot be observed is a shortcoming, and critique has been raised about the model's accuracy. Critics have questioned the CAPM for not being applicable in practice since the market portfolio has to be approximated (French, 2003).

4 Data

This section of the research paper describes the data as well as the data sources that have been used in all of the calculations, regressions, and comparisons.

4.1 Risk-Free Rate

For our risk-free rate, we use the 30-day Treasury Bill rates from The Swedish Riksbank. This data is collected from Thomson Reuters Datastream (Datastream, 2019). The sample period is 15 years of monthly data, collected on the last day each month between December 2003 and December 2018.

4.2 Data Used for Portfolio Construction

When constructing our diversified market portfolios, we use data which is collected from Bloomberg Professional, Thomson Reuters Datastream, NASDAQ OMX Nordic, The Swedish National Debt Office and Statistics Sweden (SCB).

In the first portfolio that we construct, we use the returns from OMX Stockholm 30 Index (OMXS30) which is a value-weighted index of the 30 most traded companies on the Stockholm Stock Exchange (NASDAQ OMX, 2019b). The data is collected from Thomson Reuters Datastream (Datastream, 2019).

The second portfolio is created by using the returns of OMX Stockholm PI index, which consists of all listed equities on NASDAQ OMX Stockholm (currently 336 listed companies)(NASDAQ OMX, 2019a). We also collect the companies' total monthly market value, which is used to calculate our portfolio weights. The data is collected from Thomson Reuters Datastream (Datastream, 2019). The data over all the listed equities on NASDAQ OMX Stockholm is being used in all of the other portfolios.

In the third portfolio, we add treasury securities to the equities that we used in our second portfolio. We use the returns of the OMRX Bond index, which is a value-weighted bond index consisting of treasury bonds that have a maturity greater or equal to one year issued by The Swedish National Debt Office. The data is collected from Thomson Reuters Datastream (Datastream, 2019). We also collect the outstanding monthly value from The Swedish National Debt Office, which is used to calculate the portfolio weights (Swedish National Debt Office, 2019).

In the fourth portfolio, we add real estate, and the constituents are therefore equities, treasury securities, and real estate. The data used for real estate is the yearly assessed value of all real estate properties in Sweden. The data is collected from Statistics Sweden (Statistics Sweden (SCB), 2019a; Statistics Sweden (SCB), 2019b).

In our fifth portfolio, we replace the real estate with corporate bonds issued by companies registered in Sweden. The returns of these corporate bonds are obtained from the S&P Sweden BBB Investment Grade Corporate Bond Index, which consists of bonds with the lowest credit rating of BBB- (Standard & Poor, 2019). The data is collected from Thomson Reuters Datastream (Datastream, 2019). We also collect the corporate bonds total outstanding value from Statistics Sweden, which later is used to calculate our portfolio weights (Statistics Sweden (SCB), 2019c).

In our sixth and last portfolio, we add real estate, see the explanation of our fourth portfolio. This makes the sixth portfolio the broadest consisting of both equities, government bonds, corporate bonds, and real estate.

The sample period for our first-, second-, third- and fourth portfolio is 15 years of monthly data, collected on the last day each month between December 2003 and December 2018. Our fifth- and the sixth portfolio has a sample period of 5 years of monthly data, collected on the last day each month between December 2013 and December 2018 due to limited data of the corporate bonds market value.

4.3 NASDAQ OMX Stockholm Sector Indices

When calculating the estimated beta values, on the left-hand side of the asset pricing test CAPM, we use the excess returns of 30 industry indices of the NASDAQ OMX Stockholm stock market. The indices are value-weighted and cover a different number of companies in each industry. The data for the indices are drawn from Bloomberg Professional (Bloomberg, 2019).

The sample period for our 30 Industry Indices is 15 years of monthly data, collected on the last day each month between December 2003 and December 2018.

5 Empirical Design

In this section, we present our empirical model and approach towards testing our research question. We describe every step of the process and all of the calculations that are being used.

5.1 Portfolio Construction

The first and most crucial step of our empirical research is the creation of our diversified market portfolios. Our research is based on value-weighted portfolios, and those are constructed using the data described in chapter four.

5.1.1 Portfolio Constituents

When constructing our market portfolios, we use several different portfolio constituents. The different portfolio combinations are presented below, along with a section explaining how we calculate the different portfolio weightings.

The first portfolio, conveniently named “Portfolio 1 (P1)”, is constructed by using the OMXS30 index which is covering the 30 largest companies on NASDAQ OMXS.

Our second portfolio named “Portfolio 2 (P2)” is used to identify if there are any advantages of using the full stock market of NASDAQ OMX Stockholm (which currently consists of 336 companies, (NASDAQ OMX, 2019a)) or if it is sufficient to use the OMXS30-index as the equity-only market portfolio.

Following the portfolio consisting of all equities listed at NASDAQ OMX Stockholm, we construct “Portfolio 3 (P3)”, where we add treasury bonds issued by the Swedish Government. Returns of these bonds are gathered through the index called OMRX Treasury Bonds, which is an index showing the value growth trend of a portfolio holding Swedish treasury bonds (NASDAQ OMX, 2018).

The next step in diversifying our market portfolio is adding real estate to "Portfolio 4 (P4)". It is important to note that we use the assessed value of all real estate properties in Sweden and not the value of real estate companies. The assessed value of the real estate is lower than the price when buying and selling real estate, but we are confident that it follows the same trend and will, therefore, have the same returns.

In our fifth portfolio, "Proxy 5 (P5)", we remove the real estate added in the previous step and replace it with corporate debt. The corporate debt returns are collected from the S&P Sweden BBB Investment Grade Corporate Bond Index, which consists of bonds with the lowest credit rating of BBB- (Standard & Poor, 2019).

Our last portfolio, "Proxy 6 (P6)", is the one that is supposed to be the broadest proxy. Hence, we add all the previously included assets which are: all equities on the NASDAQ OMX Stockholm, Swedish treasury securities, Swedish corporate debt, and Swedish real estate.

5.1.2 Portfolio Weighting

As mentioned earlier, our market portfolios are value weighted. These weights are calculated through the market value of each asset class. When calculating the weights, we use the following formula:

$$\frac{MV_n}{MV_m} = w_n \quad (5.)$$

Where MV_n is the market value of asset n, MV_m is the total market value of the whole market m, and w_n is the calculated weight of asset class n. The calculated average weights are summarized in the table below.

Table 1: Market Portfolio Weights

	Equities	T-Bonds	Corporate Debt	Real Estate
Portfolio 1	100%			
Portfolio 2	100%			
Portfolio 3	85.3%	14.7%		
Portfolio 4	42.2%	7.2%		50.6%
Portfolio 5	67.1%	8.4%	24.5%	
Portfolio 6	37.9%	4.7%	13.8%	43.7%

5.2 Calculations

In this section, we present the methods that we use to calculate the values needed for testing if betas substantially change when diversifying the market portfolios. We need both the total return and the excess return (market risk premium) of our diversified market portfolios. Furthermore, we also need the expected return of our 30 industry indices. We calculate the estimated betas of our 30 industry indices, and then we crosscheck the calculated betas with linear regressions. Lastly, we calculate the estimated cost of equity for our 30 industry indices based on the new betas.

5.2.1 Total Returns of our Diversified Market Portfolios and 30 Industry Indices

The total returns of our diversified market portfolios and 30 industry indices are the monthly change in percent of each portfolio. These are used to calculate their excess returns (i.e., the market risk premium used in CAPM).

5.2.2 Excess Returns of our Diversified Market Portfolios and 30 Industry Indices

The monthly excess returns of our diversified market portfolios are calculated as:

$$r_n - r_f = z_n \quad (6.)$$

Where r_n is the monthly total return of portfolio n, r_f is the risk-free rate, and z_n is the excess returns of portfolio n.

The monthly excess returns of our 30 industry indices are calculated as:

$$r_i - r_f = z_i \quad (7.)$$

Where r_i is the monthly total return of index i, r_f is the risk-free rate, and z_i is the excess returns of index i.

5.2.3 Real Estate Monthly Growth Rate

The assessed real estate values collected from Sweden Statistics (Statistics Sweden (SCB), 2019a; Statistics Sweden (SCB), 2019b) are only registered annually. This created difficulty for us, as all of the other data are reported and collected with a monthly frequency. To solve this, we compounded the annual growth rate to a monthly frequency instead. The formula we used to do this is the following:

$$(8.)\qquad \left(\frac{r_t}{r_{t-1}}\right)^{\frac{1}{12}} - 1 = \theta$$

Where r_t is the annual growth rate, and θ is the compounded growth rate per month. It is also important to note that this is an approximation, as the equation returns only one growth rate which stays the same each month during a full year.

5.2.4 Estimated Betas

To see how the betas change with a diversified market portfolio, we calculate new betas and their difference compared to Portfolio 1, which is the most commonly used market portfolio when using asset pricing tests. The formula is constructed as follows:

$$(9.)\qquad \frac{Cov(r_i, r_n)}{Var(r_n)} = \beta_{i,n}$$

Where r_i represents the monthly returns of industry index i, and r_n represents the monthly return of the market portfolio proxy n. $\beta_{i,n}$ refers to the beta of industry index i, calculated with market portfolio proxy n.

5.2.5 Linear Regressions for Crosschecking Calculated Betas

We run regressions with a 95%-confidence interval that we use to crosscheck our calculated betas. When we run the regressions, we plot the excess returns of each industry index portfolio on the Y-axis and the excess returns of each diversified market portfolio on the X-axis. In each regression result-table, we collect the coefficient value and compare it to its corresponding calculated beta.

5.2.6 Estimated Monthly Cost of Equity (CoE)

We calculate the estimated monthly cost of equity to compare it between the different diversified market portfolios by using the CAPM-formula, the excess returns of our market portfolios, and our calculated betas. The formula is constructed as follows:

$$r_f + \beta_{i,n}(r_n - r_f) = CoE_i \quad (10.)$$

Where r_f refers to the risk-free rate, $\beta_{i,n}$ is the beta value of a specific industry index portfolio i relative to market portfolio proxy n, and r_n refers to the return of the market portfolio proxy n. Lastly, CoE_i equals the cost of equity for industry index portfolio i.

5.2.7 Annualization of Estimated Cost of Equity (CoE)

To get a better understanding of the impact of our adjusted betas after calculating the estimated cost of equity per month, we choose to annualize the results. This is done with the following formula:

$$(1 + CoE_i)^{12} - 1 = CoE_{annual,i} \quad (11.)$$

6 Empirical Findings

In this section, we present the results and the statistics of our findings. Firstly, we describe how beta-estimates are affected. Secondly, we report the estimated cost of equity.

6.1 Estimation of Market Betas

Appendix Table 1 presents the difference in estimated betas of the 30 industry portfolios comparing Portfolio 1 and Portfolio 2. P1 contains only equities included in the OMXS30 index while P2 contains all equities listed at Nasdaq OMX Stockholm. The average percentage change in the beta estimates is 2.38%, which suggests that the changing of market proxy and including the total equities market does not have a substantial effect on the estimated market risk. Although, the majority of the differences are positive, which means that in most cases, the individual portfolio is more volatile when the market portfolio proxy contains all publicly traded stocks compared to only the OMXS30 index. The highest beta moves from 1.67 to 1.68, and the minimum beta moves from 0.30 to 0.31, which also confirms that there is only a marginal change between the two proxies (Table 11, Appendix). Table 1-6 portrays the estimated betas using 95% confidence intervals.

Appendix Table 2 presents the difference in estimated betas of the 30 industry portfolios comparing Portfolio 1 and Portfolio 3. P3 contains equities and government bonds. The table reports that adding government bonds affects estimates of industry portfolio betas. In all cases, adding bonds increases the beta substantially. The highest increase is 30.99%, and the smallest is 12.19%. The mean beta goes from 0.85 to 1.01, and an average difference of 20.75% (Table 11, Appendix).

Appendix Table 3 presents the difference in estimated betas of the 30 industry portfolios comparing Portfolio 1 and Portfolio 4. P4 contains equities, government bonds, and real estate. The estimated betas increase for all portfolios. The mean beta is 1.68, and the highest and lowest estimates are 2.28 and 0.73, respectively (Table 11, Appendix). The average increase in beta is 103.17% comparing the equity only market portfolio proxy P1 and P4.

Appendix Table 4 presents the difference in estimated betas of the 30 industry portfolios comparing Portfolio 1 and Portfolio 5. P5 contains equities, government bonds, and corporate debt. The mean estimated beta is 1.23, and the median of the estimates is at 1.27 (Table 11, Appendix). The average increase in beta is 62.66%, and the percentage change ranges from a minimum of 69.15% and a maximum of 471.24%. The standard deviation is 39.12%, which indicates a significant variation within the sample.

Appendix Table 5 presents the difference in estimated betas of the 30 industry portfolios comparing Portfolio 1 and Portfolio 6. P6 is the broadest proxy containing equities, government bonds, corporate bonds, and real estate. The mean beta is 2.03, the median is 2.05, and the standard deviation is 64% (Table 11, Appendix). For all industry portfolios except for one, there is an increase in estimated betas – the average difference in beta is 1.19 or 168.42%.

6.2 Cost of Equity (CoE)

In this section, we calculate the cost of equity of the industry portfolio indices. Using the CAPM framework, the expected return on one of the industry portfolios equals the risk-free rate plus the product of the beta, and the excess return of the market portfolio. The market portfolio's excess return is calculated as the sample mean of the excess return each month for each proxy.

The annualized sample mean of the estimated cost of equity is 11.44% of the equity-only proxy, P1. When we compare with the other equity-only proxy, the difference in estimations is minimal. The annual cost of equity estimates of P2 is 11.43%, which means that the difference compared to P1 is only ten basis points. The most substantial difference is -0.46%, and the smallest is 0.00% (Table 6, Appendix).

When adding treasury securities in terms of government bonds, the differences in the estimations are grater. The sample mean of the estimated cost of equity is 10.97%, suggesting a lower return than the equity-only proxies indicate. The average difference compared to P1 is -0.48%, and the differences range from -2.95% to 2.11% (Table 7, Appendix). When adding real estate to the market portfolio, the estimated cost of equity is reduced further. The sample mean of estimates is 8.95% while the average difference compared to P1 is -2.49% and the differences range from -14.25% to 11.77% (Table 8, Appendix). In P5, when we replace real estate with corporate bonds, the estimated cost of equity increase compared to the estimates in P4 (Table 9, Appendix). The sample mean is 11.43%, which is almost precisely identical to the estimates of P1 and P2. When we compare the variation within the sample, the sample standard deviation of P5 is 9.22% while for P1 and P2, 6.13 and 6.26% respectively, indicating that the estimates of P5 fluctuate more. The mean difference between the estimates compared to P1 is 0.09%.

When we estimate the cost of equity and include all security types – equity, government bonds, real estate, and corporate debt – the sample mean is 9.61%. Within the sample, the estimates range from -19.22% to 54.44%, suggesting a significant variation (Table 10, Appendix). The sample standard deviation is 15.28%, which is the largest for all proxies. The average difference compared to the equity only proxy P1 is -1.47% ranging from -18.21% to 36.15%.

When we compare the estimates, the difference is not very large at first glance. The difference when we compare the market portfolio proxy P1, which only contains equities with the one that contains all asset classes, the difference is 183 basis points. In economic terms, that makes a massive difference. For example, when calculating future cash flows the estimated cost of equity will be used as the discount rate and will be essential.

7 Conclusions

In the following section, we comment and conclude our findings. We also give suggestions to future research opportunities within fields that are not covered in this thesis.

7.1 Summary and Conclusions

Analyzing the results, an important finding is adding more asset classes to the market portfolio substantially increase the betas. When adding government bonds, all industry portfolios become more sensitive to the market risk compared to an equity-only market portfolio. The increase in beta is expected from a theoretical perspective, as the beta value is a function of the covariance between the individual asset's excess return and the variance of the excess return of the market portfolio. The industry portfolios used as the explanatory variables include only equities and are highly correlated with the equities market. When adding government bonds, we add securities less correlated with the industry portfolios. Thus, when we include the additional asset classes to the market portfolio proxy, the beta values increase. Hence, we observe increased risk exposure to the market. The real estate and corporate debt components have a substantial effect on the beta estimates in all cases – which makes the industry portfolios more sensitive when using a broader market portfolio proxy.

All things equal, the smaller the variance of the market portfolio, the higher the beta estimate. We observe an increase in betas when adding more asset classes to the market portfolio conditionally that the covariance is constant. This is expected, as the risk is spread between different types of assets. Therefore, we conclude that the increased betas are likely a consequence of a lower covariance between the industry portfolios and the market portfolio, along with a decrease of the market portfolios' variance due to the diversification.

An alternative way to view a portfolio's beta is to view it as the contribution to the variance of the market portfolio. As the variance of the market portfolio decreases when we add more asset classes, the risk of the market portfolio also decreases, along with a decrease in expected returns. The cost of equity estimates decrease when adding government bonds, real estate, and corporate debt. This is because the market excess return decreases since the variance of the market portfolio decreases. The Security Market Line (SML) is a function of beta, and the excess return is the slope. Therefore, the slope becomes less steep when the return of the market portfolio decreases.

The CAPM assumes the market portfolio to be the optimal portfolio for any investor to hold. Over time a passive strategy where the investor holds the market portfolio will, therefore, outperform any stock-picking strategy. To compare, we have investigated what Swedish public pension funds hold in their portfolios and if their portfolios are weighted similarly to our market portfolio proxies. The new legislation concerning fixed income securities and unlisted assets are in line with our findings. In our market portfolio proxies, the equity-weights and government bond-weights are restricted. The new legislation allows a minimum of 20% to be allocated to fixed income securities with low credit risk. In our market proxy containing all asset classes (P6), the weight of government bonds is only an average of 4.7% (see Table 1, p.16), which is way beneath the threshold faced by the Swedish public pension funds. Nonetheless, government bonds are not very risky. The pension funds should not be exposed to large financial risks, and therefore, the heavy weight of government bonds is not necessarily harmful in this perspective.

The reason why government debt and equities are being reduced in the public pension funds' portfolios is because of the low market rates we have observed in later years. This is also something we observe in the market portfolio proxy composition over time. Also, the part that contains alternative investments is being increased and is now, in contrast to previous years, allowed to be above 5% of the total fund's portfolio. This category of assets includes real estate since they are illiquid. The development of increasing the weights of real estate is confirmed by our proxies – on average, P6 contain 43.7% real estate (see Table 1, p.16). Therefore, the change of the legislation is in line with what we find in our study, and we believe that the updated legislation is more aligned to the characteristics of the capital markets in Sweden today.

7.2 Future Research Opportunities

We have focused on the theory behind CAPM in our research and not covered the multi-factor models such as; Fama-French Three Factor Model (FF3M), the Fama-French Five Factor Model (FF5M) or the Arbitrage Pricing Theory (APT). In the paper *"Yes, the Composition of the Market Portfolio Matters: The Estimated Cost of Equity"* (Kamara & Young, 2018), the authors do include tests of the FF3M but not nearly as in-depth as with the CAPM.

Furthermore, even though we have constructed six different market portfolios with different levels of diversification, we cannot conclude that our sixth portfolio is perfect and complete. There are still asset classes such as, e.g., commodities and private equity, that can be added to the market portfolio, which would result in an even broader diversification. One of the problems that we found when collecting the data is also that the timespan should preferably be a lot longer. It would be interesting to see if the trend that we observe in our results is robust over time.

Finally, our analysis has only covered the Swedish financial markets, and according to the theoretical foundation, the market portfolio should be representing the global economy (Arzac, 2007). Conclusively, the tests that we run should preferably have included; the CAPM along with multi-factor models, a global market portfolio, with a more extended period, consisting of even more asset classes.

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Appendices

Table 1: Estimated beta values using Portfolio 2 (P2)

NAME	P1 BETA	P2 BETA	CHANGE IN %
TRAVEL & LEISURE	0.82	0.85	4.11%
TOBACCO	0.31	0.31	0.30%
TECHNOLOGY HARDWARE & EQUIPMENT	0.87	0.84	-3.69%
SUPPORT SERVICES	0.75	0.78	3.68%
SOFTWARE & COMPUTER SERVICES	0.93	0.97	4.49%
REAL ESTATE INVESTMENT & SERVICES	0.84	0.88	5.24%
PHARMACEUTICALS & BIOTECHNOLOGY	0.54	0.55	1.20%
PERSONAL GOODS	0.77	0.78	1.10%
OIL & GAS PRODUCERS	0.87	0.94	7.67%
MOBILE TELECOMMUNICATIONS	0.64	0.62	-2.12%
MINING	1.67	1.68	0.71%
MEDIA	1.17	1.22	3.63%
GOODS	0.72	0.78	7.32%
INDUSTRIAL TRANSPORTATION	0.77	0.77	0.48%
INDUSTRIAL METALS & MINING	1.13	1.15	1.56%
INDUSTRIAL ENGINEERING	1.15	1.15	0.33%
HHLD GOODS & HOME CONSTRUCTION	1.00	1.02	2.03%
GENERAL RETAILERS	0.63	0.60	-4.50%
FORESTRY & PAPER	0.87	0.90	3.06%
FOOD PRODUCERS	0.54	0.58	7.99%
FOOD & DRUG RETAILERS	0.44	0.47	8.01%
FIXED LINE TELECOMMUNICATIONS	0.74	0.74	0.00%
FINANCIAL SERVICES	0.98	1.00	1.11%
ELECTRONIC & ELECTRICAL EQUIPMENT	1.05	1.09	3.51%
ELECTRICITY	0.83	0.85	3.02%
CONSTRUCTION & MATERIALS	0.97	0.99	2.18%
CHEMICALS	0.30	0.31	4.53%
BANKS	1.10	1.07	-2.61%
AUTOMOBILES & PARTS	0.98	1.02	3.95%
AEROSPACE & DEFENSE	0.98	1.01	3.22%

Table 2: Estimated beta values using Portfolio 3 (P3)

NAME	P1 BETA	P3 BETA	CHANGE IN %
TRAVEL & LEISURE	0.82	1.00	22.16%
TOBACCO	0.31	0.39	26.27%
TECHNOLOGY HARDWARE & EQUIPMENT	0.87	0.99	13.91%
SUPPORT SERVICES	0.75	0.93	22.66%
SOFTWARE & COMPUTER SERVICES	0.93	1.13	22.67%
REAL ESTATE INVESTMENT & SERVICES	0.84	1.05	24.68%
PHARMACEUTICALS & BIOTECHNOLOGY	0.54	0.67	23.73%
PERSONAL GOODS	0.77	0.91	18.85%
OIL & GAS PRODUCERS	0.87	1.06	22.00%
MOBILE TELECOMMUNICATIONS	0.64	0.74	15.83%
MINING	1.67	1.94	16.33%
MEDIA	1.17	1.40	19.52%
GOODS	0.72	0.92	26.65%
INDUSTRIAL TRANSPORTATION	0.77	0.91	17.92%
INDUSTRIAL METALS & MINING	1.13	1.32	16.99%
INDUSTRIAL ENGINEERING	1.15	1.35	17.29%
HHLD GOODS & HOME CONSTRUCTION	1.00	1.19	18.73%
GENERAL RETAILERS	0.63	0.71	12.19%
FORESTRY & PAPER	0.87	1.06	21.53%
FOOD PRODUCERS	0.54	0.70	30.10%
FOOD & DRUG RETAILERS	0.44	0.57	29.92%
FIXED LINE TELECOMMUNICATIONS	0.74	0.88	18.78%
FINANCIAL SERVICES	0.98	1.16	17.93%
ELECTRONIC & ELECTRICAL EQUIPMENT	1.05	1.26	19.82%
ELECTRICITY	0.83	1.00	20.88%
CONSTRUCTION & MATERIALS	0.97	1.15	19.16%
CHEMICALS	0.30	0.39	30.99%
BANKS	1.10	1.24	13.06%
AUTOMOBILES & PARTS	0.98	1.19	21.17%
AEROSPACE & DEFENSE	0.98	1.18	20.80%

Table 3: Estimated beta values using Portfolio 4 (P4)

NAME	P1 BETA	P4 BETA	CHANGE IN %
TRAVEL & LEISURE	0.82	1.69	106.42%
TOBACCO	0.31	0.73	135.90%
TECHNOLOGY HARDWARE & EQUIPMENT	0.87	1.63	87.25%
SUPPORT SERVICES	0.75	1.58	109.25%
SOFTWARE & COMPUTER SERVICES	0.93	1.93	108.22%
REAL ESTATE INVESTMENT & SERVICES	0.84	1.74	106.61%
PHARMACEUTICALS & BIOTECHNOLOGY	0.54	1.22	126.17%
PERSONAL GOODS	0.77	1.56	103.24%
OIL & GAS PRODUCERS	0.87	1.63	87.75%
MOBILE TELECOMMUNICATIONS	0.64	1.29	103.02%
MINING	1.67	3.15	88.30%
MEDIA	1.17	2.28	94.38%
GOODS	0.72	1.55	113.47%
INDUSTRIAL TRANSPORTATION	0.77	1.52	97.31%
INDUSTRIAL METALS & MINING	1.13	2.13	88.39%
INDUSTRIAL ENGINEERING	1.15	2.14	86.75%
HHLD GOODS & HOME CONSTRUCTION	1.00	1.94	94.57%
GENERAL RETAILERS	0.63	1.16	82.95%
FORESTRY & PAPER	0.87	1.76	101.17%
FOOD PRODUCERS	0.54	1.22	125.96%
FOOD & DRUG RETAILERS	0.44	1.03	133.58%
FIXED LINE TELECOMMUNICATIONS	0.74	1.53	105.60%
FINANCIAL SERVICES	0.98	1.86	88.44%
ELECTRONIC & ELECTRICAL EQUIPMENT	1.05	1.98	88.70%
ELECTRICITY	0.83	1.71	106.59%
CONSTRUCTION & MATERIALS	0.97	1.87	93.01%
CHEMICALS	0.30	0.73	143.23%
BANKS	1.10	2.00	81.68%
AUTOMOBILES & PARTS	0.98	2.01	103.80%
AEROSPACE & DEFENSE	0.98	1.99	103.51%

Table 4: Estimated beta values using Portfolio 5 (P5)

NAME	P1 BETA	P5 BETA	CHANGE IN %
TRAVEL & LEISURE	0.82	0.77	-5.43%
TOBACCO	0.31	1.09	250.28%
TECHNOLOGY HARDWARE & EQUIPMENT	0.87	1.52	75.33%
SUPPORT SERVICES	0.75	1.29	70.27%
SOFTWARE & COMPUTER SERVICES	0.93	1.51	63.40%
REAL ESTATE INVESTMENT & SERVICES	0.84	1.16	38.07%
PHARMACEUTICALS & BIOTECHNOLOGY	0.54	1.56	190.18%
PERSONAL GOODS	0.77	0.90	17.47%
OIL & GAS PRODUCERS	0.87	1.56	80.06%
MOBILE TELECOMMUNICATIONS	0.64	0.68	6.85%
MINING	1.67	1.75	4.91%
MEDIA	1.17	1.03	-12.07%
GOODS	0.72	1.26	74.15%
INDUSTRIAL TRANSPORTATION	0.77	0.24	-69.15%
INDUSTRIAL METALS & MINING	1.13	1.61	42.06%
INDUSTRIAL ENGINEERING	1.15	1.73	50.70%
HHLD GOODS & HOME CONSTRUCTION	1.00	0.93	-7.13%
GENERAL RETAILERS	0.63	0.83	31.43%
FORESTRY & PAPER	0.87	1.63	87.03%
FOOD PRODUCERS	0.54	1.41	162.55%
FOOD & DRUG RETAILERS	0.44	0.33	-26.02%
FIXED LINE TELECOMMUNICATIONS	0.74	1.19	59.72%
FINANCIAL SERVICES	0.98	1.41	42.88%
ELECTRONIC & ELECTRICAL EQUIPMENT	1.05	1.42	35.51%
ELECTRICITY	0.83	1.08	30.85%
CONSTRUCTION & MATERIALS	0.97	1.24	28.33%
CHEMICALS	0.30	1.71	471.24%
BANKS	1.10	1.06	-3.70%
AUTOMOBILES & PARTS	0.98	1.53	55.84%
AEROSPACE & DEFENSE	0.98	1.31	34.08%

Table 5: Estimated beta values using Portfolio 6 (P6)

NAME	P1 BETA	P6 BETA	CHANGE IN %
TRAVEL & LEISURE	0.82	1.14	39.06%
TOBACCO	0.31	1.69	445.41%
TECHNOLOGY HARDWARE & EQUIPMENT	0.87	2.62	201.27%
SUPPORT SERVICES	0.75	2.09	176.98%
SOFTWARE & COMPUTER SERVICES	0.93	2.50	170.09%
REAL ESTATE INVESTMENT & SERVICES	0.84	1.90	125.93%
PHARMACEUTICALS & BIOTECHNOLOGY	0.54	2.68	398.44%
PERSONAL GOODS	0.77	1.61	109.43%
OIL & GAS PRODUCERS	0.87	2.81	223.80%
MOBILE TELECOMMUNICATIONS	0.64	1.26	96.92%
MINING	1.67	2.82	69.01%
MEDIA	1.17	1.89	61.16%
GOODS	0.72	2.01	178.18%
INDUSTRIAL TRANSPORTATION	0.77	0.49	-35.97%
INDUSTRIAL METALS & MINING	1.13	2.68	137.57%
INDUSTRIAL ENGINEERING	1.15	2.86	148.97%
HHLD GOODS & HOME CONSTRUCTION	1.00	1.44	44.28%
GENERAL RETAILERS	0.63	1.41	122.21%
FORESTRY & PAPER	0.87	2.62	199.90%
FOOD PRODUCERS	0.54	2.36	338.16%
FOOD & DRUG RETAILERS	0.44	0.48	8.43%
FIXED LINE TELECOMMUNICATIONS	0.74	2.02	171.03%
FINANCIAL SERVICES	0.98	2.32	135.22%
ELECTRONIC & ELECTRICAL EQUIPMENT	1.05	2.30	119.18%
ELECTRICITY	0.83	1.98	139.09%
CONSTRUCTION & MATERIALS	0.97	2.00	106.46%
CHEMICALS	0.30	2.67	790.42%
BANKS	1.10	1.77	60.98%
AUTOMOBILES & PARTS	0.98	2.49	152.56%
AEROSPACE & DEFENSE	0.98	2.13	118.52%

Table 6: Estimated Cost of Equity (COE) using Portfolio 2

NAME	P1 COE	P2 COE	DIFFERENCE
TRAVEL & LEISURE	7.52%	7.25%	-0.27%
TOBACCO	13.37%	13.37%	0.00%
TECHNOLOGY HARDWARE & EQUIPMENT	6.69%	6.96%	0.27%
SUPPORT SERVICES	8.35%	8.14%	-0.21%
SOFTWARE & COMPUTER SERVICES	11.46%	11.34%	-0.13%
REAL ESTATE INVESTMENT & SERVICES	13.85%	13.82%	-0.02%
PHARMACEUTICALS & BIOTECHNOLOGY	11.01%	10.97%	-0.04%
PERSONAL GOODS	10.59%	10.55%	-0.04%
OIL & GAS PRODUCERS	17.64%	17.89%	0.26%
MOBILE TELECOMMUNICATIONS	5.83%	6.00%	0.17%
MINING	26.54%	26.63%	0.09%
MEDIA	0.82%	0.36%	-0.46%
GOODS	19.53%	19.92%	0.39%
INDUSTRIAL TRANSPORTATION	6.08%	6.04%	-0.04%
INDUSTRIAL METALS & MINING	5.18%	5.05%	-0.14%
INDUSTRIAL ENGINEERING	11.23%	11.22%	-0.01%
HHLD GOODS & HOME CONSTRUCTION	6.61%	6.46%	-0.15%
GENERAL RETAILERS	9.28%	9.51%	0.22%
FORESTRY & PAPER	6.54%	6.31%	-0.23%
FOOD PRODUCERS	13.07%	12.97%	-0.10%
FOOD & DRUG RETAILERS	13.30%	13.22%	-0.08%
FIXED LINE TELECOMMUNICATIONS	17.54%	17.54%	0.00%
FINANCIAL SERVICES	14.34%	14.34%	0.00%
ELECTRONIC & ELECTRICAL EQUIPMENT	23.69%	24.03%	0.34%
ELECTRICITY	-1.02%	-1.45%	-0.43%
CONSTRUCTION & MATERIALS	18.29%	18.47%	0.18%
CHEMICALS	12.11%	12.07%	-0.05%
BANKS	7.23%	7.41%	0.18%
AUTOMOBILES & PARTS	11.36%	11.24%	-0.12%
AEROSPACE & DEFENSE	15.24%	15.27%	0.03%

Table 7: Estimated Cost of Equity (COE) using Portfolio 3 (P3)

NAME	P1 COE	P3 COE	DIFFERENCE
TRAVEL & LEISURE	7.52%	6.07%	-1.45%
TOBACCO	13.37%	13.13%	-0.25%
TECHNOLOGY HARDWARE & EQUIPMENT	6.69%	5.66%	-1.02%
SUPPORT SERVICES	8.35%	7.04%	-1.31%
SOFTWARE & COMPUTER SERVICES	11.46%	10.82%	-0.64%
REAL ESTATE INVESTMENT & SERVICES	13.85%	13.73%	-0.12%
PHARMACEUTICALS & BIOTECHNOLOGY	11.01%	10.24%	-0.77%
PERSONAL GOODS	10.59%	9.90%	-0.69%
OIL & GAS PRODUCERS	17.64%	18.38%	0.74%
MOBILE TELECOMMUNICATIONS	5.83%	4.54%	-1.29%
MINING	26.54%	28.64%	2.11%
MEDIA	0.82%	-1.64%	-2.46%
GOODS	19.53%	20.96%	1.43%
INDUSTRIAL TRANSPORTATION	6.08%	4.66%	-1.42%
INDUSTRIAL METALS & MINING	5.18%	3.70%	-1.48%
INDUSTRIAL ENGINEERING	11.23%	10.70%	-0.53%
HHLD GOODS & HOME CONSTRUCTION	6.61%	5.22%	-1.39%
GENERAL RETAILERS	9.28%	8.68%	-0.60%
FORESTRY & PAPER	6.54%	4.93%	-1.61%
FOOD PRODUCERS	13.07%	12.70%	-0.37%
FOOD & DRUG RETAILERS	13.30%	13.00%	-0.30%
FIXED LINE TELECOMMUNICATIONS	17.54%	18.16%	0.61%
FINANCIAL SERVICES	14.34%	14.34%	0.00%
ELECTRONIC & ELECTRICAL EQUIPMENT	23.69%	25.63%	1.94%
ELECTRICITY	-1.02%	-3.97%	-2.95%
CONSTRUCTION & MATERIALS	18.29%	19.55%	1.26%
CHEMICALS	12.11%	11.70%	-0.42%
BANKS	7.23%	6.34%	-0.90%
AUTOMOBILES & PARTS	11.36%	10.74%	-0.62%
AEROSPACE & DEFENSE	15.24%	15.43%	0.19%

Table 8: Estimated Cost of Equity (COE) using Portfolio 4 (P4)

NAME	P1 COE	P4 COE	DIFFERENCE
TRAVEL & LEISURE	7.52%	0.70%	-6.82%
TOBACCO	13.37%	12.10%	-1.27%
TECHNOLOGY HARDWARE & EQUIPMENT	6.69%	0.42%	-6.27%
SUPPORT SERVICES	8.35%	2.16%	-6.19%
SOFTWARE & COMPUTER SERVICES	11.46%	8.45%	-3.02%
REAL ESTATE INVESTMENT & SERVICES	13.85%	13.35%	-0.50%
PHARMACEUTICALS & BIOTECHNOLOGY	11.01%	6.97%	-4.04%
PERSONAL GOODS	10.59%	6.86%	-3.73%
OIL & GAS PRODUCERS	17.64%	20.62%	2.98%
MOBILE TELECOMMUNICATIONS	5.83%	-2.31%	-8.14%
MINING	26.54%	38.31%	11.77%
MEDIA	0.82%	-10.57%	-11.39%
GOODS	19.53%	25.71%	6.18%
INDUSTRIAL TRANSPORTATION	6.08%	-1.41%	-7.49%
INDUSTRIAL METALS & MINING	5.18%	-2.33%	-7.51%
INDUSTRIAL ENGINEERING	11.23%	8.61%	-2.62%
HHLD GOODS & HOME CONSTRUCTION	6.61%	-0.23%	-6.85%
GENERAL RETAILERS	9.28%	5.26%	-4.02%
FORESTRY & PAPER	6.54%	-0.83%	-7.37%
FOOD PRODUCERS	13.07%	11.52%	-1.55%
FOOD & DRUG RETAILERS	13.30%	11.95%	-1.35%
FIXED LINE TELECOMMUNICATIONS	17.54%	21.04%	3.50%
FINANCIAL SERVICES	14.34%	14.35%	0.02%
ELECTRONIC & ELECTRICAL EQUIPMENT	23.69%	32.59%	8.90%
ELECTRICITY	-1.02%	-15.27%	-14.25%
CONSTRUCTION & MATERIALS	18.29%	24.20%	5.91%
CHEMICALS	12.11%	10.10%	-2.01%
BANKS	7.23%	1.75%	-5.49%
AUTOMOBILES & PARTS	11.36%	8.36%	-3.00%
AEROSPACE & DEFENSE	15.24%	16.20%	0.96%

Table 9: Estimated Cost of Equity (COE) using Portfolio 5 (P5)

NAME	P1 COE	P5 COE	DIFFERENCE
TRAVEL & LEISURE	7.52%	7.88%	0.36%
TOBACCO	13.37%	11.04%	-2.33%
TECHNOLOGY HARDWARE & EQUIPMENT	6.69%	1.25%	-5.44%
SUPPORT SERVICES	8.35%	4.33%	-4.02%
SOFTWARE & COMPUTER SERVICES	11.46%	9.69%	-1.78%
REAL ESTATE INVESTMENT & SERVICES	13.85%	13.67%	-0.18%
PHARMACEUTICALS & BIOTECHNOLOGY	11.01%	4.97%	-6.04%
PERSONAL GOODS	10.59%	9.95%	-0.64%
OIL & GAS PRODUCERS	17.64%	20.36%	2.72%
MOBILE TELECOMMUNICATIONS	5.83%	5.27%	-0.56%
MINING	26.54%	27.16%	0.63%
MEDIA	0.82%	2.36%	1.55%
GOODS	19.53%	23.54%	4.01%
INDUSTRIAL TRANSPORTATION	6.08%	11.72%	5.64%
INDUSTRIAL METALS & MINING	5.18%	1.54%	-3.64%
INDUSTRIAL ENGINEERING	11.23%	9.69%	-1.54%
HHLD GOODS & HOME CONSTRUCTION	6.61%	7.15%	0.53%
GENERAL RETAILERS	9.28%	7.74%	-1.54%
FORESTRY & PAPER	6.54%	0.17%	-6.37%
FOOD PRODUCERS	13.07%	11.07%	-2.00%
FOOD & DRUG RETAILERS	13.30%	13.56%	0.26%
FIXED LINE TELECOMMUNICATIONS	17.54%	19.51%	1.97%
FINANCIAL SERVICES	14.34%	14.34%	0.01%
ELECTRONIC & ELECTRICAL EQUIPMENT	23.69%	27.18%	3.49%
ELECTRICITY	-1.02%	-5.35%	-4.34%
CONSTRUCTION & MATERIALS	18.29%	38.77%	20.48%
CHEMICALS	12.11%	11.50%	-0.62%
BANKS	7.23%	7.49%	0.25%
AUTOMOBILES & PARTS	11.36%	9.74%	-1.62%
AEROSPACE & DEFENSE	15.24%	15.55%	0.32%

Table 10: Estimated Cost of Equity (COE) using Portfolio 6 (P6)

NAME	P1 COE	P6 COE	DIFFERENCE
TRAVEL & LEISURE	7.52%	4.97%	-2.55%
TOBACCO	13.37%	9.25%	-4.12%
TECHNOLOGY HARDWARE & EQUIPMENT	6.69%	-7.27%	-13.96%
SUPPORT SERVICES	8.35%	-1.52%	-9.87%
SOFTWARE & COMPUTER SERVICES	11.46%	6.76%	-4.71%
REAL ESTATE INVESTMENT & SERVICES	13.85%	13.26%	-0.59%
PHARMACEUTICALS & BIOTECHNOLOGY	11.01%	-1.30%	-12.32%
PERSONAL GOODS	10.59%	6.64%	-3.95%
OIL & GAS PRODUCERS	17.64%	25.39%	7.75%
MOBILE TELECOMMUNICATIONS	5.83%	-1.84%	-7.67%
MINING	26.54%	35.65%	9.12%
MEDIA	0.82%	-6.70%	-7.52%
GOODS	19.53%	29.37%	9.84%
INDUSTRIAL TRANSPORTATION	6.08%	8.98%	2.90%
INDUSTRIAL METALS & MINING	5.18%	-6.29%	-11.48%
INDUSTRIAL ENGINEERING	11.23%	6.76%	-4.46%
HHLD GOODS & HOME CONSTRUCTION	6.61%	3.35%	-3.26%
GENERAL RETAILERS	9.28%	3.41%	-5.88%
FORESTRY & PAPER	6.54%	-7.57%	-14.11%
FOOD PRODUCERS	13.07%	8.95%	-4.12%
FOOD & DRUG RETAILERS	13.30%	13.21%	-0.09%
FIXED LINE TELECOMMUNICATIONS	17.54%	23.25%	5.71%
FINANCIAL SERVICES	14.34%	14.36%	0.03%
ELECTRONIC & ELECTRICAL EQUIPMENT	23.69%	35.78%	12.09%
ELECTRICITY	-1.02%	-19.22%	-18.21%
CONSTRUCTION & MATERIALS	18.29%	54.44%	36.15%
CHEMICALS	12.11%	9.81%	-2.30%
BANKS	7.23%	3.11%	-4.12%
AUTOMOBILES & PARTS	11.36%	6.98%	-4.38%
AEROSPACE & DEFENSE	15.24%	16.34%	1.10%

Table 11: Summary statistics of changes to estimated beta values

	PORTFOLIO 1	PORTFOLIO 2	PORTFOLIO 3	PORTFOLIO 4	PORTFOLIO 5	PORTFOLIO 6
MEAN	0.85	0.86	1.01	1.68	1.23	2.03
MEDIAN	0.85	0.87	1.02	1.70	1.27	2.05
ST.DEV	0.28	0.28	0.32	0.48	0.39	0.64
MAX	1.67	1.68	1.94	3.15	1.75	2.86
MIN	0.30	0.31	0.39	0.73	0.24	0.48