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Empirical Risk Factors in Realized Stock Returns

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Empirical Risk Factors in Realized Stock Returns

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Abstract:
Measuring risk in the stock market context is one of the key challenges of modern finance. Despite of the substantial significance of the topic to investors and market regulators, there is a controversy over what risk factors should be used to price the assets or to determine the cost of capital. We empirically investigate the ability of several commonly proposed risk factors to predict Swedish stock returns. We consider the sensitivity of an asset returns to the variation in market returns, the market value of equity, the ratio of market value of equity to book value of equity and the short-term historical stock returns. We conclude that none of these factors is clearly significant for explaining stock returns at the Stockholm Stock Exchange, which casts doubt on their use as universal risk factors in various corporate governance contexts. It seems that the previously documented relationship is contingent on the data sample used and on the time period.

Keywords: stock returns, asset pricing, risk, multifactor models, CAPM, size, book-to-market, momentum, Sweden

JEL: G12, C21

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1 Introduction

Modern financial theory is based on the microeconomic framework into which the concept of time is introduced (Danthine and Donaldson, 2002). Considering time implies the concern for expected return, i.e. the change in value of an asset over time. In addition, since the future is bound to be uncertain, investment in assets over time inevitably involves risk. The relationship between the two concepts – expected return and risk – is at the heart of modern finance. In the context of rational equity markets the expected return is solely determined by the underlying risk. Consequently, substantial effort has been made to model risk in this setting and to test empirically if the predictions of the models are supported by realized stock returns. The most prominent asset pricing model is the Capital Asset Pricing Model (CAPM) (Sharpe, 1964, Lintner, 1965, Mossin, 1966, Black, 1972) that proposes that the asset risk should reflect its contribution to the overall portfolio risk and should be measured as the sensitivity of an asset returns on market returns.

Despite of the intuitive appeal of CAPM and its widespread use the results of the empirical studies aimed at testing it are rather puzzling; the identified empirical patterns do not seem to be consistent with the predictions. Black, *et al.* (1972) performed one of the first empirical studies in the area testing whether portfolios consisting of stocks with high betas on average generate higher returns and found negative results. Furthermore, it soon became clear that CAPM beta does not suffice to explain the cross section of expected stock returns. Basu (1977) documented the positive significance of earnings-to-price (E/P) multiples. Banz (1981) found that size measured as the market value of equity (ME) is negatively associated with average stock returns. Stattman (1980) and Rosenberg, *et al.* (1985) found that stocks with high book-to-market equity ratios (BE/ME) on average exhibit higher returns than would be warranted by their CAPM betas. More recently, Fama and French (1992) concluded that the combination of size and BE/ME performs best in explaining the cross sectional variation in stock returns and that when these two factors are accounted for, CAPM beta becomes insignificant.

These findings on the significance of company-specific measures for average stock returns opened up a controversy over the way that they should be interpreted. Researchers following one approach attributed the relevance of the non-beta characteristics to market frictions and behavioral biases. Others argued that, despite the puzzling evidence, the pricing of stocks may be rational in the case that risk is multi-dimensional and the company-specific measures are correlated with some latent risk factors. The most common justification was that companies with low market value of their equity (i.e. small companies) and companies with low market value of equity relative to the book value of their equity (i.e. companies with high BE/ME) are likely to be financially distressed and the superior returns on their stocks represent a rational compensation that investors require for bearing a higher risk of financial distress (Chan and Chen, 1991). Fama and French (1993) formalized this idea into a three factor asset pricing model that, in addition to CAPM beta, also employs size and BE/ME as risk factors. Their model became widespread as an alternative to CAPM.

In the same year that Fama and French introduced their three factor model, Jegadeesh and Titman (1993) found that stock returns show a short-term persistence, i.e. stocks that performed well in the recent past also perform well in the near future. This effect – referred to as stock price momentum – constitutes a particular challenge to rational explanations based on the underlying risk factors. In particular, it seems contra-intuitive that while stocks with low absolute (ME) and relative market valuation (1/(BE/ME)) are seen as more risky from the viewpoint of relative distress, stocks with recent decreases in market valuation are in fact less risky, and conversely that while stocks with high absolute and relative market valuation are seen as less risky from the relative distress viewpoint, stocks with recent increases in market valuation are more risky. Fama and French (1996) concluded that their three factor model is able to explain most of the previous anomalous findings concerning the cross-sectional variation of stock returns with the exception of stock price momentum. Despite recent attempts to explain momentum by the variability in expected returns (Conrad and Kaul, 1998, Chordia and Shivakumar, 2002) momentum still constitutes one of the biggest challenges to rational asset pricing. Sadka (2006), for example, stated:

> ‘The momentum anomaly is recognized as one of the biggest challenges to asset pricing.’ (p. 310)

The ex post rationalization of these empirical risk factors casts doubt on their universality. They may capture latent risk factors as their supporters suggest, which would advocate for their use as risk proxies. However, it is also possible that the reported findings result from data mining and that the association between the identified factors are spurious and limited to specific markets or time periods. It is therefore important to analyze these relationships in different settings to improve our understanding on the degree to which they are generally applicable. Different styles of capital market regulation, corporate governance systems and the composition of the economy may have an impact on the relevance of these factors. This study is thus particularly relevant for countries whose economies and financial sectors differ substantially from the Anglo-American world, such as the Scandinavian countries (because of the specific corporate governance type), the post-communist countries (because of the different structure of the economy and limited capital market and the Asian countries (because of the specific business structures and economy type).

This study aims to analyze the ability of CAPM beta, market value of equity, book-to-market equity ratio and stock price momentum to explain the cross sectional variation in Swedish stock returns covering the period between 1979 and 2005. To do this we use standard Fama-MacBeth (1973) regressions that regress monthly excess returns on an asset on the above-mentioned proposed risk factors that are assumed to explain the realized returns. We conclude that none of these factors is clearly significant for explaining stock returns at the Stockholm Stock Exchange, which casts doubt on their se as universal risk factors. It seems that the previously documented relationship is contingent on the data sample used and on the time period. Therefore the popular three-factor model may not be an equally useful tool for determining the expected return and the cost of equity for example in the Scandinavian, post-communist and Asian countries.

The remainder of the paper is organized as follows. Section 2 reviews existing research and states the hypotheses that are tested in this study. Section 3 outlines the methodology and the data sample. In Section 4, the results of the empirical analysis are presented and discussed. Section 5 summarizes the study and concludes.

2 Previous Research

This section presents a review of existing research on factors that are likely to explain the cross-section of stock returns. First, measures are discussed that are used as risk factors in established asset pricing models – CAPM beta, size, book-to-market ratio and momentum.

2.1 *CAPM Beta*

The use of CAPM beta as a risk factor follows from the Capital Asset Pricing Model (CAPM) (Sharpe, 1964, Lintner, 1965, Mossin, 1966). The model suggests that the expected excess stock return depends on its sensitivity to the expected market return. This sensitivity is measured in terms of CAPM beta, which is defined as the covariance of an asset's return and the market return normalized by the variance of the market return. It captures the systematic and hence non-diversifiable risk faced by a well-diversified investor. Rational, risk averse investors require a compensation for facing non-diversifiable risk, which establishes the proposed positive relationship between the CAPM beta and expected stock returns. If investors' expectations are on average right, realized stock returns can be seen as proxies for expected stock returns. This motivates the first hypothesis, suggesting a positive relationship between CAPM beta and stock returns.[1]

Hypothesis 1: There is a positive association between the CAPM beta of a stock and its excess return.

2.2 *Size*

Already some of the early empirical studies that aimed at testing the CAPM concluded that CAPM beta does not suffice to explain the cross sectional variation in stock returns (Banz, 1981, Stattman, 1980, Rosenberg, *et al.*, 1985). Instead, risk seems to be multi-dimensional, as there are other factors with an incremental explanatory power (Fama and French, 1992). One of these additional factors is firm size measured as the market value of equity, ME.

The 'size effect' was first documented by Banz (1981) who found that smaller NYSE capitalization firms tend to have higher CAPM beta risk-adjusted returns than larger firms. Banz (1981) also provided the initial evidence that the size effect is not linear in the market value; the main effect occurs for very small firms while there is little difference in return between average-sized and large firms. Fama and French (1992) confirmed Banz's findings and pinpointed firm size and book-to-market equity ratio (BE/ME) as the most important determinants of average stock returns.

[1] All hypotheses are stated in the alternative form. Consequently, when stating that there is not sufficient evidence to support some of the hypotheses, it is implicitly meant that there is not sufficient evidence to refute their corresponding null forms.

There are a number of reasons why size is likely to capture some dimension of risk. Chan, *et al.* (1985) found that the earning prospects of small capitalization firms are more sensitive to macroeconomic risk factors than are those of large capitalization firms; in particular they seem to be more exposed to production risks and changes in the risk premium. Chan and Chen (1991) argued that the higher sensitivity of small firms to macroeconomic events is because many of the small firms are what they called ‘marginal firms’, i.e. firms with poor past performance that are financially distressed, which manifests itself in high market-imposed financial leverage and cut-downs in dividend payouts. Thus, size can be seen as one of the proxies for the risk of financial distress. In fact, provided that stock prices are rational, there should be a nearly mechanistic relationship between size and risk. Berk (1995) argued that regardless of how investors assess risk, the riskier stocks have higher required returns, which *ceteris paribus* leads to lower prices. Hence, even if doubt remains about the risk characteristics relevant to investors, it can be concluded that price conveys some information about required returns and hence about the perceived risk. Stocks that are deemed riskier (for whatever reason) are overrepresented in small capitalization stocks and therefore size can serve as a risk proxy (even though a very noisy one). In addition, information provided by smaller firms is not as thoroughly scrutinized by stock market analysts, which introduces additional uncertainty about the expectations of the company’s prospects and about its valuation. To sum up, small capitalization firms seem to be riskier and hence it is reasonable to expect investors to require a premium for holding them. The second hypothesis addresses this relationship.

Hypothesis 2: There is a negative relationship between the size of a firm and its excess stock returns.

2.3 Book-to-Market Ratio

Another empirically discovered factor related to the cross-sectional variation in stock returns is book-to-market ratio (BE/ME), which is defined as the ratio of a firm’s book value of equity to its market value. Early evidence suggesting the relevance on BE/ME for returns of U.S. stocks was provided by Stattman (1980) and Rosenberg, *et al.* (1985). Chan, *et al.* (1991) confirmed the positive association between BE/ME and stock returns on the Japanese market. Fama and French (1992) concluded that ME and BE/ME are superior to other risk factor candidates (such as E/P ratio or leverage) in explaining the cross section of stock returns. In a later paper, they used CAPM beta, size and BE/ME to construct the three factor model that should capture the various dimensions of risk (Fama and French, 1993) and in a follow-up paper to this, they argued that the three factor model offers a sound solution for a number of CAPM anomalies (Fama and French, 1996).

It is often argued that similarly to size BE/ME also captures some dimension of financial distress risk.[2] BE/ME seems to be related to operating performance of a company. Penman (1991) and Fama and French (1995) showed that low BE/ME equity firms exhibit persisting higher profitability than the high BE/ME equity ones. This result holds across different size-BE/ME groups of stocks. High BE/ME corresponds to low relative market valuation of equity, which indicates that the market is on average skeptical about company prospects, which entails a higher required cost of equity. Griffin and Lemmon (2002) show that the returns required on firms exposed to high distress risk exhibit a much greater sensitivity to the unit change in the BE/ME of these firms than do the returns of non-distressed firms. They further show that the BE/ME effect is most prominent for small firms with poor analyst reports. From the ‘agnostic perspective’, which infers information about investors’ risk assessment based on stock prices, disregarding the way risk is actually assessed. Berk (1995) argued that as a risk indicator, BE/ME should be superior to size (ME) because, by relating ME to BE, differences in cash flow expectations across firms are partially controlled. High BE/ME firms have low market valuation relative to the book value of equity, which indicates that they are likely to be distressed. Investors require a compensation for holding high BE/ME stocks; hence the proposed positive association between BE/ME that is addressed with the third hypothesis.

Hypothesis 3: There is positive association between the BE/ME of a firm and its excess stock returns.

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[2] Alternatively, it is also possible to interpret the relevance of BE/ME for stock returns as a result of market overreaction to series of news about the company’s prospects. Gradual unraveling may lead to a stock price correction that can be anticipated by high or low relative market valuation, i.e. the inverse of BE/ME (Lakonishok, *et al.*, 1994).

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Contrary to the international evidence, however, size and BE/ME seem to perform rather oddly on the Swedish Stock Exchange. Asgharian and Hansson (2000) tested the three factor model with time-varying CAPM beta on Swedish data extracted from the Trust database for the period 1980 – 1996. They concluded that in the Swedish capital market, CAPM beta and size are both insignificant. They attributed this result to the considerable effects of the Swedish crisis period in the years 1990 – 94 and to the length of their sample. This present study uses a longer time period and a somewhat different methodology, which should give an indication of whether the results of Asgharian and Hansson (2000) are an artifact of the short time period, as they themselves suggested, or whether they are representative of the Swedish market.

2.4 Momentum

Short term persistence in stock returns – momentum – constitutes a rather puzzling empirical finding. Momentum was first empirically documented in studies by De Bondt and Thaler (1985, 1987) who showed that past winners (stocks with high returns over the preceding five years) outperform past losers over a short investment horizon (lasting for several months). However, the authors did not concentrate on this finding as they analyzed the results for long investment horizons (5 years) for which the pattern reverses. The first empirical study with an explicit focus on momentum was performed by Jegadeesh and Titman (1993). They showed that using a strategy of buying past winners, i.e. stocks that performed well in the preceding 3 to 12 months, and selling past losers yields an excess return of approximately 1% per month. Later, they showed that positive excess returns on momentum strategies also persisted in the 1990s (Jegadeesh and Titman, 2001). Rouwenhorst (1998) provided international evidence showing momentum returns for twelve non-US markets.

Unless these findings can be attributed to some risk characteristics, systematically higher returns on stocks with a positive momentum would violate the weak form of stock market efficiency defined by Fama (1970). Grundy and Martin (2001), as well as Brennan, *et al.* (1998), showed that momentum returns cannot be fully captured by CAPM, nor by the three factor model. Hence, it has been suggested that momentum proxies for some risk dimension and thus it is sometimes used as the fourth factor in empirical pricing models. When examining the relative importance of individual factors, Subrahmanyam (2005) showed that

BE/ME and momentum are actually the most robust risk factors in capturing the cross-sectional variation of stock returns.

Even though momentum is sometimes used in asset pricing models, rational explanations which justify momentum as a risk factor are still tenuous. Several theoretical models have been proposed, but there is little consensus about the plausibility of these models. Conrad and Kaul (1998) argued that momentum arises because of cross-sectional variability in expected returns. Stocks with high past-realized returns are likely to have high expected returns, which generates a momentum which is driven by variation in the systematic risk of the firm. Chordia and Shivakumar (2002) suggested that the cross-sectional variation in expected returns is driven by a set of standard macroeconomic variables. Berk, *et al.* (1999) developed a model in which the changes in the systematic risk of a firm (and hence in its expected returns) are based on the adoption of investment opportunities, which changes the mix of the assets and growth opportunities of the firm. They showed that simulations based on this model produce momentum in stock prices.

These models, however, are not unproblematic. Jegadeesh and Titman (2001) argued that the reversals in the post-holding period cast doubt on the variation in expected returns as an explanation for momentum returns. Hong, *et al.* (2000) found that momentum strategies work better for stocks with lower analyst coverage, which is consistent with a slow diffusion of information among investors. Hence, some argue that momentum is driven by investor irrationality, namely by the under-reaction to news that only slowly becomes incorporated into stock prices. This behavioral argument is similar to the one supporting post-earnings announcement drift (Bernard and Thomas, 1990), which seems to be one of the most intriguing stock market anomalies (Kothari, 2001). In fact, Daniel, *et al.* (1998) and Barberis, *et al.* (1998) developed models that attribute the existence of momentum to cognitive biases rather than to risk. The fourth hypothesis aims at confirming the ability of momentum to predict stock return in the Swedish market.

Hypothesis 4: There is a positive association between momentum and excess stock returns.

The overview provided in this section indicates that the proposed risk factors differ greatly in their theoretical underpinning. While the use of CAPM beta has a solid theoretical backing in the portfolio theory, the relevance of the other factors (size, BE/ME and momentum) was first documented empirically and only afterwards was the theoretical basis for why these could constitute risk proxies provided and formalized into models. The plausibility of such ex post justifications is subject to question.

3 Research Design

3.1 Methodology

For each set of explanatory factors a series of monthly cross-sectional Fama-MacBeth (1973) type regressions of dividend-adjusted excess stock returns are run on the explanatory factors. Each month, realized excess returns are matched with the explanatory variables computed at the beginning of the month. This generates up to 254 monthly estimates for each explanatory variable, the mean values of which are reported in the tables as the estimated slope coefficient. To assess their significance, we use *t*-statistic, computed as the ratio of the mean estimated monthly coefficient and the standard deviation divided by the square root of the number of monthly regressions.

Realized monthly excess returns (defined as raw stock return minus risk-free return) are used as a proxy for expected returns. Market expectations (not even in the form of analysts' expectations) are not observable on monthly basis, which necessitates the use of realized returns as proxies. This involves an implicit assumption that the market expectations are on average 'right' and hence the realized monthly returns are representative of their expectations at the beginning of the period. Furthermore, monthly returns on three-month Swedish Governmental Bonds are used as a proxy for the risk-free asset. This is because the data on one-month Swedish Governmental Bonds prior 1993 are not available. The choice of the risk-free proxy is not expected to have any significant impact on the results, since the correlation between the two series over the period between November 1993 and May 2005 is 0.972 and the average difference between the two returns series is merely 0.002%.

This study acknowledges that CAPM betas may change over the sample period (27 years). Hence, for every stock, CAPM beta is re-estimated at the beginning of each month by means of longitudinal rolling window regressions of individual stock excess returns on market excess returns over the preceding 60 months[3]. This seems to represent a default estimation procedure from the viewpoint of the practitioners, as the resulting beta estimates are readily

[3] A minimum requirement of at least 48 pairs of observations to be available for CAPM beta estimation is made.

available in the business press (e.g. for companies listed in the Stockholm Stock Exchange in the business weekly magazine Affärsvärlden) as well as in financial databases (e.g. the Trust database provided by Six Estimates and DataStream provided by Thomson Financial). A standard Swedish stock market index Affars Varlden General Index (AFGX) is used as a proxy for the market return. This follows the recommendation of Bartholdy and Peare (2001, 2005), who concluded that the use of five years of monthly data and an equal-weighted market index provide the most efficient beta estimates.

As a proxy for size, the natural logarithm of the market value of equity *ln*(ME) is used, computed on the basis of the stock price at the beginning of the month, times the total number of stocks. The transformation by natural logarithm is used to make the distribution of the size variable closer to normal for the OLS estimation by improving the symmetry (introducing negative values) reduces the effect of observations with very large ME, the distribution of which tends to be skewed. To construct the book-to-market equity ratio (BE/ME), use is made of the common shareholders' equity from the accounting period ending at least three months before the beginning of the month and the market value of equity from the beginning of the month. The minimum three-month lag follows a standard procedure (e.g. Basu, 1983) that ensures that the accounting information is known to the market at that time. Momentum ($R^{-7,-1}$) is defined as the dividend-adjusted ex-post raw return on the stock over six-month period ending at the beginning of the month of the regression.

Each month we run a cross sectional regression of asset excess return on several sets of repressors following this format:

$$\left(R_{i,t}^{0} - R_{f,t}^{0}\right) = \lambda_0 + \lambda_1 \hat{\beta}_{i,t} + \lambda_2 \ln\left(ME\right)_{i,t} + \lambda_3 \left(BE/ME\right)_{i,t} + \lambda_4 R_{i,t}^{-7,-1} \qquad \ldots \forall t$$

where $R_{i,t}$ are realized stock returns on an asset *i* in month *t*, $R_{f,t}$ is the estimate of the risk free rate in month *t*, ($R_{i,t} - R_{f,t}$) is thus the realized excess return (exret) on an asset *i* in month *t*, $\hat{\beta}_{i,t}$ is the CAPM beta estimate on an asset *i* in month *t* based on the preceding 60 months (beta), $\ln(ME)_{i,t}$ is a proxy for size measured by the natural logarithm of the market value of equity, $(BE/ME)_{i,t}$ is the ratio of the book to market value of equity, and $R_{i,t}^{-7,-1}$ is the stock price momentum of an asset *i* in month *t* defined as the past 6-month dividend-adjusted stock return.

3.2 Data Sample

Data was gathered from the Six Trust Database on all the companies listed on the Stockholm Stock Exchange (SSE) between 1979 and 2005. A standard procedure is followed (e.g. that of Fama and French, 1992). All financial and insurance companies are excluded because their specific asset and liability structure typically produces high financial leverage, which hinders the comparability of their BE/ME ratios with non-financial firms. A stock's share price in month *t* is defined as the closing purchase price on the last trading day in a given month. In total the sample comprises of 609 stocks (with 59 248 firm-month observations for excess stock returns) for which 254 monthly regressions are run (satisfying the condition of a minimum of 48 past monthly observations required for CAPM beta estimation).[4]

SSE is of interest for several reasons. First, most of the empirical risk factors (size, BE/ME, momentum) have been discovered and analyzed on several large, typically Anglo-American, markets. Stock return performances on these markets are highly correlated (Engsted and Tanggaard, 2004). The Scandinavian corporate governance system is usually described as distinct from both the Anglo-American and Germanic corporate governance systems (La Porta and Lopez-de-Silanes, 1999). Swedish data thus provide out of sample evidence that can be used to verify the significance of the factors in an environment with different characteristics and to draw conclusions about their generality. This seems to be particularly important given the empirical (rather than theoretical) basis of most of the commonly used risk-factors (Conrad, *et al.*, 2003). Second, SSE is a reasonably large stock exchange with quite a heterogonous composition of stocks. The size of the data sample and its diversity allows robust inferences to be drawn about the significance of the proposed risk factors.

Table 1 provides descriptive statistics based on monthly observations of all the variables used. Panel A uses the full data sample as obtained from the Trust database, whereas in Panel B the data is based on a sample that has been treated for outliers by Winsorizing the data at 3 standard deviations. The full sample results are reported because there has been some concern that the risk characteristics captured by some of the variables (e.g. ME) may possibly be concentrated in the extremes, and therefore removing the extreme observations may potentially bias the results. However, the inclusion of outliers is not suitable for all purposes.

[4] The actual number of firm-year observations and the number of monthly regressions varies somewhat across different specifications because of data availability.

To this end, outliers are treated by Winsorizing all variables at 3 standard deviations, i.e. all values that are further than 3 standard deviations away from the mean are replaced by the value equal to the mean plus or minus 3 standard deviations. This adjusted sample should be robust to potential mistakes in the database or to the effect of outlying observations. For example, Winsorizing reduces the range of excess stock returns from -101.3% to 502.6% in the original sample to -48.7% to 50.3% in the adjusted sample and beta estimates from -0.482 to 4.370 in the full sample to -0.482 to 2.480 in the Winsorized sample.[5]

Table 2 shows the pairwise correlations between variables together with the corresponding *p*-values. Again, Panel A uses the full data sample, whereas Panel B is based on the sample Winsorized at 3 standard deviations. Table 2 gives some initial indications concerning the relationships between the studied variables. It can be observed that the correlation between beta and excess returns is indeed very weak (in fact, somewhat negative for the Winsorized sample). The correlations with excess returns for both the size and BE/ME have the expected sign (negative for size and positive for BE/ME) giving some indication that the three factor model may indeed remedy some of the deficiencies of CAPM, but only the correlation of size to excess returns in the full sample is statistically significant. The correlation of excess returns with momentum, on the other hand, is positive and significant in both samples, suggesting that momentum is likely to be an important factor for explaining the cross section of stock returns.

Further analysis reveals a number of interrelations between the regressors. Large companies tend to have higher past stock returns (momentum) and, perhaps as a consequence, lower BE/ME. High beta stocks tend to be somewhat larger, which is hardly surprising given that it is primarily the returns on large companies that actually determine the market return, and thus their return sensitivity to market returns (beta) is likely to be higher. Consequently, high beta companies tend to be related to the other regressors much like large companies, though in a weaker manner. The following section tests the relationships more formally with the use of monthly cross-sectional regressions.

[5] As a robustness check, all the regressions have been re-run after removing "unusual" observations with excess returns, or momentum < -1, or with bid-ask spread > 0. These results do not materially differ from Winsorized results.

4 Results

In this section, the significance of proposed risk factors is tested. First, the importance of the individual factors for stock returns is assessed separately, then the risk factors included in the three factor model (CAPM beta, size, BE/ME) are tested jointly and finally the factors constituting the four factor model (CAPM beta, size, BE/ME, momentum) are examined in combination.

The results are shown in Table 3 for values based on the complete sample and in Table 4 for values based on the sample Winsorized at 3 standard deviations for each variable. Each specification shows runs in which excess returns are regressed on one or more factors, as apparent in the tables.

4.1 CAPM

Specification 1 in Table 3 shows the mean slope coefficient and *t*-statistic from monthly regressions of dividend-adjusted realized excess returns on CAPM beta estimates. The results do not support CAPM predictions. In particular, the slope coefficient of CAPM beta is insignificantly negative (rather than positive) with a *t*-statistic equal to -0.343. In addition, the intercept that represents the unexplained portion of returns is positive significant (rather than insignificant) with the *t*-statistic of 2.519. A comparison of these two results with the ones presented in Table 4, which are based on the outlier-free sample, shows that neither of them is driven by extreme observations. After Winsorizing at 3 standard deviations, CAPM beta becomes even more significant (*t*-statistic -0.962), while the intercept remains virtually unchanged (*t*-statistic 2.511). These results imply that when CAPM beta is estimated in the way customarily used by practitioners, it has no significant power to explain the cross-section of stock returns and at the same time, it leaves a significant portion of excess returns unexplained. Hypothesis 1 is thus rejected. This finding is consistent with Asgharian and Hansson (2000), who found that CAPM beta is insignificant in the Swedish market.

This evidence suggests that CAPM indeed fails to capture the underlying risk characteristics of stocks. In fact, the association between beta estimates and realized excess stock returns seems to be marginally negative, which is puzzling. In the following subsections common alternatives to CAPM will be considered – namely the three factor and four factor models –

and analysis will be made of whether their ability to capture the systematic risk of stocks is superior to CAPM.

4.2 Three Factor Model

The three factor model aims at capturing risk across several dimensions by complementing the CAPM beta with two additional risk factors – size (*ln*(ME)) and book-to-market equity ratio (BE/ME). It is typically presented as an alternative to CAPM, designed in response to the poor power of CAPM beta to explain the cross section of stock returns documented on the U.S. market (Fama and French, 1992). It is often argued that both size and BE/ME capture a different dimension of risk; namely the risk of financial distress. Therefore the association between size and returns is expected to be negative, i.e. smaller firms are riskier and therefore they should generate higher return, and the association between BE/ME and returns is expected to be positive, i.e. high BE/ME firms are more likely to be financially distressed and therefore they should generate higher return. Considering the empirical origin of these risk factors, it is particularly important to consider whether they are also applicable in different corporate governance settings, which should give some indication about whether they can be seen as universal risk proxies or whether their validity is limited to only certain settings.

Table 3 shows that when excess returns are regressed on *ln*(ME) and BE/ME separately (specifications 2 and 3), both coefficients have the predicted sign (negative for size and positive for BE/ME), but neither is statistically significant at the 5% level (BE/ME approaches significance with a *p*-value of 6.8%). The conformity of the sign with the prediction does not, however, hold for size for the Winsorized sample (Table 4), in which the average slope coefficient for size becomes marginally positive with a *t*-value of 0.613. This may be because the size effect is indeed asymmetric, being, as suggested by Banz (1981), concentrated in the very small companies. Note that Winsorizing altered the minimum *ln*(ME) from -2.469 to 0.870, which corresponds to the change in the minimum ME from 0.085 mil SEK to 2.387 mil SEK. Hence, if the size effect is concentrated in the very small firms, Winsorizing is likely to eliminate it. Consequently, there is not enough evidence to support Hypotheses 2 and 3. It can also be noted that the intercept terms in specifications 2 and 3 are somewhat smaller than in specification 1, indicating that size and especially BE/ME may be more capable than beta in capturing risk characteristics on a standalone basis.

The two additional risk factors do not seem to be superior to CAPM beta when used in combination in a form of the three factor model (specification 5). In both samples, they are insignificant with *t*-statistics ranging from -0.413 to 0.604. In addition, the inclusion of *ln*(ME) and BE/ME renders beta even more negative while keeping the intercept still close to significant. This result is contrary to the prediction of the relative distress explanation for the three factor model, and it indicates that the model does not seem to be a universal alternative to CAPM. While there is some evidence that the individual factors may be related to excess stock returns in the predicted direction, when used in combination they lack significance.

These findings are broadly consistent with the conclusions drawn by Asgharian and Hansson (2000). On a substantially shorter sample of Swedish data, covering the period between 1983 and 1996, they found the results for CAPM beta and size to be insignificant, while BE/ME was positive significant. The longer sample used here confirms the findings on the insignificance of CAPM beta and size, but for BE/ME the results differ. Despite being positive, the result for the BE/ME in this present study is not significant, which indicates that the conclusions of Asgharian and Hansson on the positive significance of BE/ME may have been an artifact of the time period that they analyzed.[6]

4.3 Four Factor Model

In this subsection we consider the stock price momentum defined as the dividend-adjusted six-months past stock return. Previous studies have documented that stock prices show short term persistence. To our knowledge the existence of this phenomenon has not yet been tested for validity in the Swedish stock market. Tables 3 and 4 show that, when used as the only regressor (specification 4), the slope coefficient for momentum does indeed have a positive sign, which corresponds with the expectations. Nevertheless, it is only significant for the Winsorized sample (*t*-statistic of 2.642). Thus, there is only limited evidence to support Hypothesis 4 and this is contingent on the treatment of outliers. This seems to indicate that past momentum does indeed predict future stock returns, but it is unable to capture extreme

[6] Nevertheless, it is also possible that, even though a longer time frame is used for this study, the findings may be less suitable for making a general conclusion. This paradoxical statement stems from the fact that the late 1990s featured a rather unusual SSE performance. In that this period can be seen as unrepresentative of general market conditions, the conclusions of Asgharian and Hansson, which exclude the late 1990s, can be seen as more generalizable.

stock return performances, which seems to be consistent with the theoretical understanding of the concept. Furthermore, specification 6 shows that momentum seems to be the only factor presented so far that preserves a portion of its significance (albeit very low) when used in conjunction with the other risk factors (with a *t*-statistic of 1.002 for the full sample and 1.357 for the Winsorized sample).

Thus, momentum seems to be, at least relatively, the most robust of the four risk factors considered. Somewhat paradoxically, it is also the factor with the least theoretical underpinning to explain why it actually should capture the risk characteristics of stocks. Furthermore, the logic underpinning the risk interpretation of the momentum does not seem to be quite consistent with the logic supporting the use of size as a risk proxy. It seems contra-intuitive to accept that if something is small in terms of market value of equity then it is riskier, but at the same time it becomes riskier when it grows, i.e. when there is a positive stock price momentum. Therefore momentum seems to be the most relevant pricing factor, but the underlying reasons remain elusive.

5 Summary and Conclusion

This study tests the ability of commonly proposed risk factors to explain the cross section of stock returns. Fama-MacBeth (1973) regressions are used to empirically test this proposition on data from the Stockholm Stock Exchange. The results show that capturing risk on the Swedish stock market is indeed rather problematic as none of the established risk factors (beta, size and BE/ME) seems to be significantly related to the excess stock returns. This may indicate either that the risk-return relationship does not hold on average, or that the measures examined in this study are unable to capture the risk effectively. However, in either case this implies that estimating the risk of a stock, for example for determining the implied cost of equity, is bound to be a challenging exercise. It seems that factors like the type of corporate governance and the structure of the economy of business organization effect the significance of the considered risk factors. Thus, the popular three-factor model may not be an equally useful tool for determining the expected return and the cost of equity for example in the Scandinavian, post-communist and Asian countries.

Consistent with previous research, this study concludes that the explanatory power of CAPM beta is weak. In fact, in most specifications, the association between CAPM beta and excess stock returns is if anything slightly negative. This implies that investors are in fact penalized in the form of lower realized returns for holding risky stocks that are highly correlated with market returns. Such a result is in stark contrast with the CAPM prediction, which implies that the correlation of asset returns with market returns should be the only pricing factor that rational investors consider and so the slope coefficient at CAPM beta should be significantly positive. In addition, when CAPM beta is used as the only explanatory variable, it produces a significant positive intercept, which indicates a substantial portion of unexplained return. Hence, it seems that using CAPM for determining the risk of a stock does not yield the desired results.

The three-factor model of Fama and French (1993), which besides CAPM beta also uses size and the book-to-market equity ratio, is a commonly proposed alternative to CAPM. The underlying assumption of this model is that risk is multidimensional and therefore several factors are needed to capture the multiple dimensions of risk. It is typically proposed that low absolute market valuation, i.e. size measured as (the natural logarithm of) the market value of the equity, and low relative market valuation, i.e. the inverse of the book-to-market equity ratio imply potential financial difficulties for the company. Size and BE/ME should thus capture the relative risk of financial distress that should be priced over and above the systematic risk measured by CAPM beta. The relative distress explanation, however, has been provided only after the relationship between size and BE/ME had been documented empirically. As such an *ex post* rationalization may be context specific, it is important to verify the proposed relationship on out-of-sample evidence, i.e. in a different setting, to be able to draw inferences about its universal validity. This study shows that when using Swedish data, there is only limited evidence for a negative relationship between size and stock returns, and for a positive relationship between BE/ME and stock returns, as suggested by the relative distress argument. Nevertheless, these weak relationships that are documented on a standalone basis disappear when the three factors are used jointly, as would be required when using the three factor model. Furthermore, the intercept term remains positive after the inclusion of the two additional factors (albeit somewhat lower than in the case of CAPM), which implies that the three factor model only marginally reduces the level of unexplained returns. Taken together, these findings suggest that the three factor model does not constitute a superior alternative to CAPM for estimating the risk of Swedish stocks and that its universal validity is doubtful.

Recently, stock price momentum has been considered as yet another empirically identified risk factor. The findings of short-term persistence in stock prices seem to be rather robust and they present the possibility that strong past returns on a stock increase some of the risk characteristics omitted by the previously discussed factors. Momentum arises as investors require compensation in the form of higher expected returns for holding these potentially riskier stocks. This study indeed confirms the positive relation between past and future stock returns, though its significance depends on the treatment of outliers. Momentum also remains positive when tested in conjunction with the three factors considered above in the form of the four factor model, albeit its value is not statistically significant. Despite the lack of statistical significance, momentum seems to be the strongest of the factors considered so far (possibly together with BE/ME). This empirical finding constitutes a challenge for its theoretical justification, entailing the explanation of why high past stock returns render a stock riskier. This seems to be particularly difficult in relation to the relative distress justification, which underpins the use of size and BE/ME. In particular, it seems contra-intuitive that while stocks with low absolute and relative market valuation are seen as more risky from the relative distress viewpoint, stocks with recent decreases in market valuation are in fact less risky and conversely, that while stocks with high absolute and relative market valuation are seen as less risky from the relative distress viewpoint, stocks with recent increases in market valuation are more risky.

This study highlights that measuring stock risk is a very complex issue. It confirms that arguably the only theoretically well-rooted risk proxy – CAPM beta – is unrelated to cross-sectional stock returns. It also shows, however, that the commonly proposed alternative – the three factor model – does not seem to be superior to CAPM. Even though, when they are used as standalone regressors, there is some evidence of a negative association between size and excess stock returns, and of a positive association between BE/ME and excess stock returns, their importance shrinks when they are used in combination. This suggests that the validity of the empirical pricing factors is not universal and it casts doubt on the explanation that they are correlated with some unknown risk factor. By contrast, momentum, for which the theoretical underpinning remains problematic, seems to be positively related to excess stock returns. These results indicate that measuring risk with the use of the established pricing models is indeed problematic; this may be the reason why many practitioners still use simplified procedures or rules of thumb that add different kinds of subjective risk mark-ups to the risk free rate.

Table 1 – Descriptive Statistics

Number of monthly observations (*N*), mean, standard deviations (sd), minimum (min), first quartile (p25), median (p50), third quartile (p75) and maximum (max) for the dependent variable of excess stock returns (exret), as well as all the regressors, including CAPM beta estimates based on the preceding 60 months (beta), size proxied by the natural logarithm of the market value of equity (*ln*(me)), the ratio of the book to market value of equity (be/me), momentum defined as the preceding 6-month dividend-adjusted stock return. Panel A is based on the full data sample while Panel B gives descriptives for the sample Winsorized at 3 standard deviations for each of the variables.

	exret	beta	*ln*(me)	be/me	momentum
Panel A - Full Sample					
N	59 248	39 594	57 740	54 881	58 320
mean	0.008	0.917	6.575	8.2	0.106
sd	0.165	0.521	1.901	229.3	0.479
min	-1.013	-0.482	-2.469	0.0	-0.998
p25	-0.061	0.567	5.267	0.3	-0.124
p50	-0.003	0.854	6.373	0.5	0.059
p75	0.065	1.167	7.791	0.8	0.264
max	5.026	4.370	14.680	12 844.8	19.000
Panel B - Winsorized Sample					
N	59 248	39 594	57 740	54 881	58 320
mean	0.005	0.910	6.577	1.7	0.093
sd	0.135	0.493	1.873	26.8	0.375
min	-0.487	-0.482	0.870	0.0	-0.998
p25	-0.061	0.567	5.267	0.3	-0.124
p50	-0.003	0.854	6.373	0.5	0.059
p75	0.065	1.167	7.791	0.8	0.264
max	0.503	2.480	12.279	696.2	1.542

Table 2 – Correlation Matrix

Correlation coefficients and corresponding *p*-values (reported below each coefficient) for the dependent variable of excess stock returns (exret) as well as all regressors, including CAPM beta estimate based on the preceding 60 months (beta), size proxied by the natural logarithm of the market value of equity (*ln*(me)), the ratio of the book to market value of equity (be/me), momentum defined as the past 6-month dividend-adjusted stock return. Panel A is based on the full data sample while Panel B gives descriptives for the sample Winsorized at 3 standard deviations for each of the variables.

	exret	beta	*ln*(me)	be/me	momentum
Panel A - Full Sample					
exret	1.000				
beta	0.001	1.000			
	0.846				
ln(me)	-0.023	0.044	1.000		
	0.000	0.000			
be/me	0.004	0.006	-0.147	1.000	
	0.319	0.288	0.000		
moment	0.048	0.035	0.106	-0.009	1.000
	0.000	0.000	0.000	0.047	
Panel B - Winsorized Sample					
exret	1.000				
beta	-0.009	1.000			
	0.092				
ln(me)	-0.002	0.051	1.000		
	0.591	0.000			
be/me	0.002	0.011	-0.129	1.000	
	0.581	0.036	0.000		
moment	0.079	0.004	0.139	-0.017	1.000
	0.000	0.456	0.000	0.000	

Table 3 – Full Sample Results

Mean slope coefficients (mean) and corresponding *t*-statistics (*t*-stat) from monthly cross sectional regressions of stock excess return on its CAPM beta, size, be/me, momentum, relative bid-ask spread, trading volume and stock turnover based on the complete sample. *T* gives the number of monthly regressions performed for each specification. Cons gives the intercept term. CAPM beta (beta) is estimated ex post, i.e. from rolling window regressions of stock excess returns on market excess returns based on the 60 preceding months. Size (*ln*(me)) is measured as the natural logarithm of the market value of equity in the beginning of the month. be/me is the ratio of book value of equity from the accounting period ending at least 3 months before the beginning of the month to market value of equity at the beginning of the month. Momentum is the dividend-adjusted stock return over 6 preceding months. Statistically significant coefficients are marked with (*) for 10% level, (**) for 5% level and (***) for 1% level or better.

		T	cons	beta	*ln*(me)	be/me	momentum
	predicted			(+)	(–)	(+)	(+)
1	mean	254	0.009**	-0.001			
	t-stat		2.519	-0.343			
2	mean	254	0.015*		-0.001		
	t-stat		1.859		-1.55		
3	mean	254	0.004			0.004*	
	t-stat		1.106			1.83	
4	mean	254	0.005				0.006
	t-stat		1.149				0.91
5	mean	254	0.012*	-0.003	0	0.002	
	t-stat		1.953	-0.884	-0.413	0.604	
6	mean	254	0.011*	-0.005	0	0.002	0.005
	t-stat		1.905	-1.352	-0.449	0.641	1.002

Table 4 – Winsorized Sample Results

Mean slope coefficients (mean) and corresponding *t*-statistics (*t*-stat) from monthly cross sectional regressions of stock excess return on its CAPM beta, size, be/me, momentum, relative bid-ask spread, trading volume and stock turnover based on the sample Winsorized at 3 standard deviations for each variable. *T* gives the number of monthly regressions performed for each specification. Cons gives the intercept term. CAPM beta (beta) is estimated ex post, i.e. from rolling window regressions of stock excess returns on market excess returns based on the 60 preceding months. Size (*ln*(me)) is measured as the natural logarithm of the market value of equity at the beginning of the month. be/me is the ratio of book value of equity from the accounting period ending at least 3 months before the beginning of the month to market value of equity in the beginning of the month. Momentum is the dividend-adjusted stock return over 6 preceding months. Statistically significant coefficients are marked with (*) for 10% level, (**) for 5% level and (***) for 1% level or better.

		T	cons	beta	*ln*(me)	be/me	momentum
	predicted			(+)	(–)	(+)	(+)
1	mean	254	0.009**	-0.004			
	t-stat		2.511	-0.962			
2	mean	254	0.002		0		
	t-stat		0.259		0.613		
3	mean	254	0.004			0.002	
	t-stat		0.986			1.308	
4	mean	254	0.002				0.014***
	t-stat		0.636				2.642
5	mean	254	0.009	-0.005	0	0.001	
	t-stat		1.53	-1.374	0.443	0.376	
6	mean	254	0.008	-0.005	0	0.001	0.006
	t-stat		1.406	-1.614	0.31	0.484	1.357

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