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CAPM Beta, Size, Book-to-Market, and Momentum 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 the substantial significance of the topic to investors and market regulators, there is a controversy over what risk factors should be used to price 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 asset returns to the variation in market returns (beta), the market value of equity (size), the ratio of the market value of equity to the book value of equity, and short-term historical stock returns (momentum). We conclude that none of these factors is clearly significant for explaining stock returns on 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.

1. Introduction

Much of the discourse in modern finance concerns the relationship between the expected return and risk. In the context of rational equity markets the expected return is solely determined by the underlying risk. Consequently, substantial effort has been made to identify factors that capture risk. These factors have been identified both based on the existing theories, such as the beta from the Capital Asset Pricing Model (CAPM) (Sharpe, 1964; Lintner, 1965; Mossin, 1966; Black, 1972), and empirically. 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. Jegadeesh and Titman (1993) found that stock returns show short-term persistence, i.e.,

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stocks that performed well in the recent past also perform well in the near future, which has become known as stock price momentum.

The lack of theoretical underpinning of the empirically identified factors raises doubts about their generality and about their ability to predict returns on different markets and in different time periods. It is therefore important to analyze these relationships in different settings to improve our understanding of 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 risk factors. In this study we test the relevance of these risk factors for Swedish stock returns. Our study is thus particularly relevant for countries whose economies and financial markets differ substantially from the Anglo-American world, such as the Scandinavian countries (because of the specific corporate governance type) or the post-communist countries (because of the different structure of the economy, the limited scope of the capital market, and market segmentation (Fedorova and Vaihekoski, 2009; Babetskii et al., 2007; Égert and Kočenda, 2011).

The goal of this paper is to analyze the ability of CAPM beta, the market value of equity, the 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. We use the standard Fama-MacBeth (1973) methodology, where monthly excess returns are regressed on proposed risk factors, and conclude that none of these factors is significant for explaining stock returns on the Stockholm Stock Exchange, which casts doubt on their use 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 in, for example, the Scandinavian or post-communist countries.

The remainder of the paper is organized as follows. Section 2 reviews the 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

In this section we review the factors that are likely to explain the cross-section of stock returns – 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.

Hypothesis 1:

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

2.2 Size

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 the book-to-market equity ratio (BE/ME) as the most important determinants of average stock returns.

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 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 a negative proxy for the risk of financial distress.

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

2.3 Book-to-Market Ratio

Early evidence suggesting the relevance of 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.

It is often argued that similarly to size, BE/ME also captures some dimension of financial distress risk. BE/ME seems to be related to the operating performance of a company. Penman (1991) and Fama and French (1995) showed that low BE/ME equity firms exhibit persisting higher profitability than high BE/ME equity ones. Griffin and Lemmon (2002) show that the returns required on firms exposed to high distress risk exhibit much greater sensitivity to a unit change in the BE/ME of these firms than do the returns of non-distressed firms.

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

Contrary to the international evidence, however, size and BE/ME seem to perform rather oddly on the Swedish Stock Exchange. Asgharian and Hansson (2000) conclude 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 1990–1994 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

Jegadeesh and Titman (1993) show 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, which indicates a positive persistence in stock prices. 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-U.S. markets. Grundy and Martin (2001), as well as Brennan et al. (1998), showed that momentum returns cannot be fully captured by CAPM or by the three-factor model.

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. Conrad and Kaul (1998) argue 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.

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

3. Research Design

3.1 Methodology

We run a series of monthly cross-sectional Fama-MacBeth (1973) type regressions of dividend-adjusted excess stock returns on each set of explanatory factors 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 the *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.

We use realized monthly excess returns (defined as the raw stock return minus the risk-free return) as a proxy for expected returns because the availability of analysts' recommendations, which can be seen as a better proxy of market expectations, is limited for Swedish stocks, especially in the 1980s and 1990s. Monthly returns on three-month Swedish government bonds are used as a proxy for the risk-free asset. This is because data on one-month Swedish government bonds prior to 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 return 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.[1] This seems to represent a default estimation procedure from the viewpoint of practitioners, as the resulting beta estimates are readily available in the business press (e.g., for companies listed on 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, the 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. 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 the six-month period ending at the beginning of the month of the regression.

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 those of non-financial firms. A stock's share price in month *t* is defined as the closing purchase price on the last trading day in the month. In total, the sample comprises 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).[2]

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

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

Table 1 Descriptive Statistics

Number of monthly observations (*N*), *mean*, standard deviations (*sd*), minimum (*min*), first quartile (*p*25), median (*p*50), third quartile (*p*75), 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 stand-ard 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
*p*25	-0.061	0.567	5.267	0.3	-0.124
*p*50	-0.003	0.854	6.373	0.5	0.059
*p*75	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
*p*25	-0.061	0.567	5.267	0.3	-0.124
*p*50	-0.003	0.854	6.373	0.5	0.059
*p*75	0.065	1.167	7.791	0.8	0.264
max	0.503	2.480	12.279	696.2	1.542

The 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 allow us to test the proposition about the relevance of individual risk factors in a distinct setting with different institutional characteristics and to draw conclusions about their generality across these settings. 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, the SSE is a reasonably large stock exchange with quite a heterogeneous composition of stocks. The size and diversity of the data sample allow 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,

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 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 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	

and therefore removing the extreme observations will potentially bias the results. However, the inclusion of outliers is not suitable for all purposes. To this end, the 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 a 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 the excess stock returns from –101.3% to 502.6% in the original sample to –48.7% to 50.3% in the adjusted sample and the beta estimates from –0.482 to 4.370 in the full sample to –0.482 to 2.480 in the Winsorized sample.[3]

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

[3] As a robustness check, all the regressions were 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 the Winsorized results.

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 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.

4. Results

In this section, the significance of the 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. Even though the power of tests based on short samples is limited and therefore even statistically insignificant coefficients are sometimes discussed in research articles, we follow the suggestion of an anonymous referee and we interpret the coefficients to be reliably different from 0 only if they meet the conventional benchmarks of $p < 10\%$, 5% or 1%. 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 the 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 the monthly regressions of the dividend-adjusted realized excess returns on the CAPM beta estimates. The results do not support the CAPM predictions. In particular, the slope coefficient of CAPM beta is insignificant, with a *t*-statistic equal to –0.343. In addition, contrary to the CAPM predictions the intercept that represents the unexplained portion of returns is significantly positive (rather than insignificant), with a *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 remains insignificant (*t*-statistic –0.962) and the intercept remains significantly positive (*t*-statistic 2.511). These results imply that when CAPM beta is estimated in

Table 3 Full Sample Results

Mean slope coefficients (*mean*) and corresponding *t*-statistics (*t-stat*) from monthly cross-sectional regressions of the 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 at the beginning of the month. BE/ME is the ratio of the book value of equity from the accounting period ending at least 3 months before the beginning of the month to the market value of equity at the beginning of the month. *Momentum* is the dividend-adjusted stock return over the pre-ceding 6 months.

		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 the 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 the book value of equity from the accounting period ending at least 3 months before the beginning of the month to the market value of equity at the beginning of the month. *Momentum* is the dividend-adjusted stock return over the preceding 6 months.

		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

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 the 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.

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 the 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, 1995). 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 returns, 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 returns. 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), neither coefficient is statistically significant at the 5% level (BE/ME approaches significance with a *p*-value of 6.8%). A similar conclusion can be drawn from the Winsorized sample (*Table 4*). Winsorizing altered the minimum *ln*(ME) from –2.469 to 0.870, which corresponds to a change in the minimum ME from SEK 0.085 million to SEK 2.387 million. Hence, if the size effect is concentrated in very small firms, Winsorizing would be likely to eliminate it, but we document insignificant coefficients regardless of the sample choice. 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 smaller than in specification 1 and both of them are statistically insignificant in the full sample as well as in the Winsorized sample.

The two additional risk factors do not seem to be superior to CAPM beta when used in combination in the form of the three-factor model (specification 5). In both samples, they are insignificant, with *t*-statistics ranging from –0.413 to 0.604. The inclusion of *ln*(ME) and BE/ME does not change the conclusion about the insignificance of CAPM beta. The intercept is marginally significant for the full sample (*t*-statistic 1.953) and insignificant for the Winsorized sample (*t*-statistic 1.530). 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 the CAPM, as the additional empirical factors 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 and significant. The longer sample used here confirms the findings on the insignificance of CAPM beta and size, but for BE/ME the results differ; specifically, the results for BE/ME in this present study are 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.[4]

4.3 Four-Factor Model

In this subsection we consider the stock price momentum defined as the dividend-adjusted six-month 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 expectations. Nevertheless, it is only significant for the Winsorized sample (*t*-statistic 2.642). Thus, there is only limited evidence to support Hypothesis 4 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 stock return performances, which seems to be consistent with the theoretical understanding of the concept. Nevertheless, specification 6 shows that momentum loses its significance when used in combination with the other risk factors (with a *t*-statistic of 1.002 for the full sample and 1.357 for the Winsorized sample). This casts doubt on the generality of the superior performance of the four-factor model.

Thus, momentum seems to be the only factor that is significantly related to the expected direction, albeit only in isolation. 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 momentum does not seem to be quite consistent with the logic supporting the use of size as a risk proxy. It seems counter-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 positive stock price momentum. Therefore, momentum seems relatively speaking 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, momentum) 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

[4] 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.

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 affect the significance of the risk factors considered. Thus, the popular three-factor model may not be an equally useful tool for determining the expected return and the cost of equity in, for example, the Scandinavian or post-communist countries.

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 the CAPM. 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, is positively associated with realized stock returns when tested using the Winsorized sample. However, the positive association disappears when momentum is tested in combination with the remaining three factors. These results indicate that measuring risk with the use of the established pricing models is indeed problematic and more analytical and empirical work is needed to identify risk factors that can be applied universally.

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