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Master thesis in accounting and financial management

THE SIZE EFFECT IN A VALUATION CONTEXT

A study on the relationship between firm size and risk adjusted return on the Swedish stock market

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Abstract

When valuing a company, practitioners commonly augment the discount rate with a size premium in order to compensate for small firms being riskier than large. Since a seemingly small addition can have a very large impact on firm value, it is of utmost importance to establish whether or not such an addition is applicable, and also to determine the level for this parameter. This paper, which studies returns on the Swedish stock market during the 20 year period from 1988 to 2007, provides evidence of the existence of a size effect. It also uncovers a deviation in magnitude between the size premium applied in practice and that which is suggested by empirical evidence. These findings support the augmentation of the discount rate when valuing small firms, but also advocate that practitioners of corporate valuation should revise the scale of this addition.

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1 Introduction

In the context of corporate valuation, the concept of risk, which is commonly incorporated through the discount rate in valuation frameworks, is an important variable. A slight change of this parameter will usually have a very large impact upon the derived firm value. Therefore, it is of the utmost importance that the discount rate is correctly calculated. One of the models used for estimating this parameter is the Capital Asset Pricing Model (CAPM)[1]. Although this model has been widely applied since its first appearance in 1964, it has been subject to substantial debate over the years. Especially, critics point at the fact that CAPM fails to incorporate several important risk factors and argue that this is the reason why it has shown limited ability to empirically predict stock returns. In particular, firm size as a complementary explanatory variable in determining risk, has received much attention.

In theory, large companies are better diversified than small companies and are therefore less sensitive to changes in their environment. This implies that, everything else being equal, small companies are riskier than large and should therefore be associated with a higher required return. In the initial studies of this so called "size effect" on the US stock market, Banz (1981) shows that the risk adjusted returns for small companies, i.e. the difference between realized return and return estimated by CAPM, are bigger than those for large companies. As a consequence, practitioners of corporate valuation commonly augment the required return reached using CAPM for small companies. Due to the significant impact that such a mending of the required return has on the discount rate, and thereby on the derived company value, the purpose of this study is to determine whether or not such a premium for small companies is empirically justified on the Swedish stock market. If the answer to this question turns out to be positive, an attempt will be made to determine the mathematical relationship between firm size and the risk adjusted return, as well as provide possible theoretical explanations of this phenomenon. To the best of our knowledge, no similar study has been conducted on Swedish data[2]. The following research question has been formulated:

Is there a statistically significant relationship between the risk adjusted return and company size on the Swedish stock market, and, if this is the case, how can this relationship be described?

1.1 Scope

It is assumed that historical data can be used to predict future stock development. In order to determine whether an augmentation of the required rate of return when valuing small firms is justified today, this paper therefore studies historical returns for listed companies. In other words, this paper takes an *ex post* approach in this matter. Our research is limited to the Swedish stock market and the 20-year period from January 1988 to December 2007. This period covers several phases of large gains on the stock market as well as two significant downturns, making it reasonably suited for the purpose of this study. In order to further limit the scope, we have chosen not to analyze the size effect during any sub-periods of our 20 year period. Sub periods are, however, used in order to conduct a robustness test (see 4.6 Robustness test) for the 20 year period. The paper also discusses several possible explanations to the size effect. It does not, however, provide any empirical testing of the importance of these different explanations.

[1] Initially developed by Sharpe (1964), Lintner (1965) and Black (1972)

[2] The existence of a Swedish size effect has been examined in previous graduate theses. For example, Berglund (2006) compares returns between the smallest and the largest size deciles on the Stockholm Stock Exchange from 1983 to 2005. However, he does not analyze risk adjusted returns and is hence unable to show whether a size premium is empirically justified when valuing small Swedish firms.

Although the primary purpose of this study is to determine the relationship between size and risk adjusted return, we have chosen to expand our scope to include other possible explanatory variables for the size effect, besides size itself. Two commonly used proxies for risk are the Market to book (M/B) and Dividend yield (D/P) ratios. The rationale behind the relationship between M/B and cross-sectional returns is the idea of high M/B stocks being overvalued[3]. As a consequence of being overvalued, high M/B stocks will experience smaller returns. High D/P stocks are in theory associated with lower risk and therefore lower required return since they might be expected to generate higher cash flows, pre-sale, through relatively high dividends. The relation between each respective variable to stock returns has been examined in several studies[4]. Apart from size, D/P and M/B, no other variables will be used in our empirical study.

1.2 Definitions

The definition of the *size effect* varies between studies. It has primarily been used to describe two different effects; the difference in *raw* returns between small and large companies and the difference in *risk adjusted returns*. The first definition refers to the difference in stock returns between small and large companies while the second relates to the difference in return *in excess* of those estimated by CAPM. This study, which addresses size in the context of corporate valuation, will primarily focus on the difference in risk adjusted returns. For the purposes of this study, the term size effect will therefore refer to the latter definition. When we refer to the first definition, the term *raw* size effect will be employed. The augmentation of the required rate of return for small companies due to the size effect will henceforth be labeled size premium (SP).

The return used in the data for this study is defined as the percentage change in value of the company's primary quote[5], under the assumption of dividends being reinvested instead of paid out[6]. Firm size is henceforth defined as the sum of the value of all shares outstanding, i.e. the number of stocks of each share class multiplied by each respective share class price, which also is known as the market capitalization (MC). Market to book (M/B) is defined as the MC for a company divided by its book value of equity. Dividend yield (D/P) refers to the dividend paid out divided by the total number of shares outstanding, divided by the share price of the primary quote.

1.3 Valuations with CAPM

When valuing a company, several different methods can be applied. One of the most common is the Discounted Cash Flow Method (DCF). When valuing a company using the DCF approach, the Weighted Average Cost of Capital (WACC) [7] is used to determine the rate at which expected

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[3] See Penman (2003) for a discussion of this issue

[4] Fama and French (1992) use M/B as a risk proxy variable in their model. The impact of D/P on returns is examined by Skogsvik and Skogsvik (2005)

[5] Each individual company decides for itself which of its share classes will represent the primary quote. In most cases, the primary quote refers to the most traded share class

[6] Commonly referred to as the *total return*

[7] $WACC = Re_i \times \frac{MV(E)}{MV(E)+MV(D)} + Rd_i \times (1 - T_c) \times \frac{MV(D)}{MV(E)+MV(D)}$

Where	Re_i	= Expected return for share i
	Rd_i	= Cost of debt for company i
	T_c	= Marginal tax rate
	$MV(E)$	= Market value of owners' equity
	$MV(D)$	= Market value of owners' equity

future cash flows will be discounted. A central component of the WACC is the Required Return on Equity (Re), which is commonly established using the Capital Asset Pricing Model (CAPM). A survey by Graham and Harvey (2001) conducted on US CFOs in 1999 shows that 78% of the respondents base their financial decisions on CAPM estimates.

CAPM provides a relationship between the expected return of an asset, and its inherent systematic (non diversifiable) risk, captured by the CAPM beta. Beta measures risk as the covariance of the return of an asset with the return of the market portfolio, defined as a value-weighted index of all the risky assets available on the market. Under the assumption that investors are able to lend and borrow at the risk-free rate, the CAPM formula provides a relationship between the expected return of an asset, Re, and its risk relative to the market portfolio; beta. By estimating beta for an individual stock, CAPM will provide a proxy for the required rate of return on equity. See [1] below.

[1] $$Re_i = Rf + \beta_i \times (Rm - Rf) + SP_i$$

Where

Re_i = *Expected return for share i*

Rf = *Risk free rate of return*

Rm = *Return of the market portfolio*

SP_i = *Size premium*

β_i = *Beta value for share i:* $\beta_i = \frac{Cov(R_i, R_m)}{Var(R_m)}$ *, where* R_i *= Return for share i*

However, as several empirical studies have shown that realized returns for small companies have often been larger than the expected returns estimated using CAPM (i.e. there is a size effect) practitioners have developed a method to cope with this problem. Valuation experts add an additional factor to the model. In [1], this factor is represented and quantified by the size premium (SP). A study by PwC (2009) on the risk premium of Swedish shares shows that 80% of the major Swedish actors within Corporate Finance use size related additions when determining Re. The magnitude of these additions is shown in table 1[8]. Note the stability of the SP over time for the smallest firms.

Table 1: Size premium study by PwC (2004-2009)

Size (MC)	SP 2009	SP 2008	SP 2007	SP 2006	SP 2005	SP 2004
MSEK 5000	1,2%	0,6%	1,0%	0,3%	0,6%	0,6%
MSEK 2000	1,6%	1,3%	1,3%	1,0%	1,4%	1,7%
MSEK 500	2,6%	2,5%	2,0%	2,6%	2,8%	3,0%
MSEK 100	3,9%	3,9%	3,1%	3,7%	4,0%	4,4%

[8] Table 1 is the result of a yearly survey performed by PwC Corporate Finance comprising the responses from 30 actors within Corporate Finance in Sweden including institutional investors, investment banks and advisors within Corporate Finance. They were asked to provide the addition made to the required return on equity for a company with a market value of MSEK 100, 500, 2000 and 5000 respectively

In order to illustrate the great impact for valuation purposes of incorporating the size effect, an analysis showing the sensitivity of a company's value to this parameter is presented table 2.

Consider three companies, A, B and C, all financed to 100% with owners' equity. Company A has a MC large enough not to have a SP (in this case, MSEK 7000). In the CAPM formula for both companies B and C, a SP in line with the PwC study from 2009 of 2.6% and 3.9% respectively, has been added. All companies are assumed to have a beta of 1.0. The risk free interest rate (Rf) is set to 3.0% and the market risk premium (Rm) is set to 4.0%. The nominal free cash flows (FCF) of all three companies are assumed to grow with 2.0% in perpetuity.

Table 2: Sensitivity analysis

Company	MC (in millions)	SP	CAPM Re	Value multiple of FCF
A	7000	0,0%	7,0%	20,0
B	500	2,6%	9,6%	13,2
C	100	3,9%	10,9%	11,2

For simplicity, Gordon's growth formula[9] for valuing the equity of a company is applied. Company A, to which a SP was not added due to its large size, is valued at 20.0 times its FCF. Company B and C, which are identical to company A in every respect except for size are valued at a considerably lower multiple of their FCF (13.2 and 11.2 respectively). Consequently, a SP of 3.9% compared to 0.0% implies a reduction of the value of the company of approximately 43.8% (!).

1.4 Study Outline

This study will continue with chapter 2 which will cover a description on the methodology used to conduct this study, as well as a discussion on the different types of sources used to both place this study in its proper context and analyze its results. Next, the literature review in chapter 3 will cover what has previously been written on the size effect phenomenon. Due to the large and diverse amount of research previously conducted on this theme, this chapter is extensive. However, each section has been summarized and, in addition, the chapter ends with a summary of all papers covered as well as a discussion on the relevance of this study. Chapter 4 will take the reader through the results of the various statistical tests conducted and chapter 5 will analyze these results, in the light of research presented in chapter 3. The conclusion is presented in chapter 6 and ends with suggestions on how to continue researching this field in Sweden.

[9] $Gordon's\ Growth\ Formula: V(E) = \frac{E(CF_i)_t}{Re_i - g}$

Where	$V(E)$	= Market value of owners' equity
	Re_i	= Expected return for share i
	$E(CF_i)_t$	= Expected cash flow for company i for period t
	g	= Perpetual growth in cash flow for company i

2 Methodology

The methodology used for conducting the statistical study, as well as a presentation of the sources used for analyzing the results, will be presented in this chapter. Initially, the nature of the data and how it has been processed will be explained. The chapter continues with a presentation of the statistical hypothesis testing, followed by a discussion of the validity and reliability of the statistical study.

2.1 Data and time period

In order to conduct a thorough study of the size effect in Sweden, this paper uses return data for all companies that *are or have been* listed on the Swedish stock market during the period in question. The sample has been extracted from Datastream (Thomson Reuters[10]) and is denoted as the ALLSK index which for the period includes approximately 1200 different shares. The selected time period, January 1, 1988 to December 31, 2007 was chosen since a span of 20 years is considered to be a suitable representative for historical performance[11]. 2007 was used instead of 2008 since the financial data required to conduct the study was not available for 2008 at the time the research was initiated.

2.2 The size portfolios

In order to study the size effect over time, 25 size-based portfolios were constructed each year by sorting all companies that were listed on the Swedish stock market by size (as of January 1 for each respective year). The smallest companies each year were included in portfolio 1 and the largest in portfolio 25. The size breakpoints between the portfolios were chosen so as to divide all listed companies evenly into 25 groups. The breakpoints as well as the number of companies in each portfolio will hence vary from year to year as the portfolios are rebalanced. As a consequence, the stocks included in each portfolio will vary depending on company size and the characteristics of the portfolio for the year in question. For example, a company may grow from one year to another and thereby move to another portfolio, *or*, the company's size would remain unchanged but it would still move between portfolios due to the change in breakpoints. For each company and year, the return, MC, and the M/B and D/P ratios were extracted. The number of observations for each parameter is presented in table 3.

Table 3: Number of observations per parameter

Parameter	Number of Observations
Return	5 866
Market to book	4 111
Dividend yield	5 303
Beta	5 848

[10] See www.thomsonreuters.com

[11] Other similar studies using a time span of 20 years: Lakonishok and Shapiro (1983), Marquering, Nisser and Valla (2006)

2.2.1 Share classes

MC data for a company is not readily available in Datastream. Instead, the values of all the different share classes are presented separately. In order to enable accurate matching between return and size, the value of all outstanding shares for a particular company were consolidated manually into the total MC for the company. The primary quote was chosen to represent the return development for the company.

If the value of the different share classes of a single company had not been consolidated, share classes from a single company would have been dispersed between different portfolios. Since the return on the different share classes of the same company are similar (they reflect the same fundamental values), but the size differs, there would have been a mismatch between size and return. Another approach would have been to choose one share class per company and disregard all others. This would, however, reduce the MC of the companies for which share classes are excluded, and thereby cause a similar mismatch issue.

2.2.2 CAPM and beta estimation

The risk free rate of return, defined as the average yield of a 10-year government bond[12], as well as total return for the Morgan Stanley Capital International (MSCI) Sweden Index[13] (to be used as a proxy for the market portfolio for beta and Rm estimation) was extracted for each year from Datastream. To determine beta for each company and year, 104 weekly observations were used. Opinions on how to most accurately estimate beta vary. Although a longer estimation period results in a tighter standard error for the estimate of beta, a longer estimation period also results in a higher likelihood that a significant change in the beta may have taken place; i.e. the estimated beta does not reflect the current beta due to structural changes to the firm in question. A period of 2 years was chosen since it seems to be common practice among similar studies[14]. Regarding the return interval, studies show that daily returns should always be used because daily returns result in the smallest standard error of beta or greatest precision of the beta estimate[15]. However, the bias caused by infrequent trading (covered in section 5.3.5 Infrequent trade) led us to extend the interval to weekly observations. This interval decreases the bias but does not eliminate it. As a consequence, the betas used in this study are systematically underestimated, which in turn overestimates risk adjusted returns. There are ways of correcting this error[16]. However, we find the procedures necessary for performing this correction to be beyond the scope of this thesis.

The expected return for each company, each year, was calculated using the CAPM formula, followed by a calculation of the average expected return, as well as average realized return for each portfolio each year. Next, a portfolio average expected return and average realized return for the 20 year period was calculated based on the yearly numbers. Finally, the portfolio average risk adjusted return was calculated as the difference between the realized portfolio return and the expected portfolio return, in accordance with [2]:

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[12] As 65% of the respondents in PwC (2009) indicated that they used this measure as definition of the risk-free rate, we find this measure appropriate to use in our empirical research.

[13] Datastream definition of MSCI Sweden: The index seeks to measure the performance of the Swedish equity market. It is a capitalization-weighted index that aims to capture 85% of the (publicly available) total market cap. Index is reviewed quarterly.

[14] See for example Håkansson and Persson (2005)

[15] See for example Daves, Erhardt and Kunkel (2000)

[16] See for example Dimson (1979) for an estimator method and Dimson and Marsh (1983) for the "trade-to-trade" technique

[2] $$Re^{adj}{}_{p} = Re_{p} - [Rf + \beta_{p} \times (Rm - Rf)]$$

Where

$Re^{adj}{}_{p}$ = *Risk adjusted return for portfolio p*

Re_{p} = *Realized return for portfolio p*

Rf = *Risk free rate of return*

Rm = *Return of the market portfolio*

β_{p} = *Beta value for portfolio p, calculated as the arithmetic average of all companies in portfolio p*

2.3 Regression analysis

When risk adjusted returns had been retrieved for all 25 portfolios, the relation between this variable and size was analyzed with a linear regression model in order to provide a means for estimating the SP. The *dependent variable* (the risk adjusted return for portfolio p) in the regression equation is modelled as a function of the *independent variable* (the base-ten logarithm (log) of the average MC for companies in portfolio p), a *constant* (i.e. the intercept of the linear equation) and an *error term*. The error term represents variation in the dependent variable that cannot be explained by the independent variable. The parameters are estimated so as to give a *line of best fit* of the data using an *ordinary least squares* (OLS) regression[17]. All operations were performed in Microsoft Excel 2007. [3] describes the regression equation:

[3] $$Re^{adj}{}_{p} = \propto_{0} + \propto_{1} \times log(MC_{p}) + \tilde{\varepsilon}$$

Where

$Re^{adj}{}_{p}$ = *Dependent variable (risk adjusted return for portfolio p)*

$\propto_{1}$ = *Coefficient of the independent variable*

$\propto_{0}$ = *Constant*

$log(MC_{p})$ = *Independent variable (log of average MC for companies in portfolio p)*

$\tilde{\varepsilon}$ = *Error term*

When the parameters $\propto_{0}$ and $\propto_{1}$ have been determined using portfolio data, [3] can be modified to provide an estimate for the SP for a company of any given MC, assuming that the expected risk adjusted return for company i, $E(Re^{adj}{}_{i})$, can be defined as the $\widehat{SP}_{i}$; $E(Re^{adj}{}_{i}) \equiv \widehat{SP}_{i}$. See [4] below:

[17] The OLS regression procedure obtains estimates of the linear equation coefficients $\propto_0$ and $\propto_1$ in [3] by minimizing the sum of the squared residuals, ε. The function, whose left side is labeled SSE, can be described as $SSE = \sum_{i=1}^{n}(y_i - \hat{y}_i)^2 = \sum_{i=1}^{n}\varepsilon_i^2 = \sum_{i=1}^{n}\left(y_i - (\propto_0 + \propto_1 \times x_1)\right)^2$. This is the function that is minimized. The total variability in a regression analysis (i.e. the total variability of all observations from the mean), SST, can be partitioned into two components; SSR, the deviation explained by the regression, and SSE, the unexplained error.

$$SST = SSR + SSE$$

Where

SST $= \sum_{i=1}^{n}(y_i - \overline{Y})^2$

SSR $= \sum_{i=1}^{n}(\hat{y}_i - \overline{Y})^2$

SSE $= \sum_{i=1}^{n}(y_i - \hat{y}_i)^2$

And $\overline{Y}$ is the sample mean of the dependent variable, y_i is an observed value of the dependent variable, and $\hat{y}_i$ is the estimate of the dependent variable provided by the regression function.

[4] $$E(Re^{adj}{}_i) \equiv \widehat{SP}_i = \widehat{\propto}_0 + \widehat{\propto}_1 \times log(MC_i)$$

Where

$E(Re^{adj}{}_i)$	*= Expected risk adjusted return for company i*
$\widehat{SP}_i$	*= Estimated size premium for company i*
$\widehat{\propto}_1$	*= Estimated coefficient of the independent variable*
$\widehat{\propto}_0$	*= Estimated constant*
$log(MC_i)$	*= Independent variable (log of average MC for company i)*

The error term $\hat{\varepsilon}$ is excluded in [4] since its expected value is equal to zero ($E(\hat{\varepsilon}) = 0$).

2.3.1 *Significance testing*

In order to test if the explanatory power of size for risk adjusted return is *significant*, a statistical test was conducted. Hence, a null hypothesis (H_0) as well as an alternative hypothesis (H_1) was formulated:

H_0: Risk adjusted return cannot be explained by size
H_1: Risk adjusted return is explained by size

The purpose of the statistical test is to establish whether the data contradicts the null hypothesis or not. This can be done by testing the *significance* of the null hypothesis. A *significance level* of 5% has been chosen for testing this hypothesis, which means that the null hypothesis will only be rejected if the probability of generating a particular outcome, given that the null hypothesis is true, falls below 5%. Obviously, the lower the significance level at which a null hypothesis can be rejected, the greater the doubt cast on its truth.

Rather than testing a hypothesis at a pre-assigned level of significance, it is possible to determine the smallest level of significance at which a null hypothesis can be rejected. This is denoted *p-value* and is defined as the probability of obtaining a value of the test statistic as extreme as, or more extreme than, the actual value obtained when the null hypothesis is true, i.e. if there were no relationship between the two variables[18].

The hypothesis of different means between populations is tested with a *t test*. The t statistic relates the coefficient estimator, $\widehat{\propto}_1$, to its standard error. The larger the coefficient (in absolute terms) and the smaller the standard error, the larger the absolute value of the t statistic[19]. Under the null hypothesis, this ratio has a Student's t distribution. To test the null hypothesis H_0: $\beta_1 = 0$ against the two-sided alternative H_1: $\beta_1 \neq 0$, where β_1 is the population's regression slope, the decision rule is[20]:

Reject H_0 if $\frac{\widehat{\propto}_1 - 0}{s_{\widehat{\propto}_1}} \geq t_{n-2,\alpha/2}$ or $\frac{\widehat{\propto}_1 - 0}{s_{\widehat{\propto}_1}} \leq -t_{n-2,\alpha/2}$

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[18] See Newbold, Carlsson and Thorne (2003)

[19] This follows from the t-statistic being defined as:
$t = \frac{\widehat{\propto}_1 - \beta_1}{s_{\widehat{\propto}_1}}$, where β_1 is the population regression slope, $\widehat{\propto}_1$is the coefficient estimator and $s_{\widehat{\propto}_1}$is its standard error.

[20] If the sample size is large enough for the central limit theorem to apply, the test can be conducted even if the errors (ε) are not normally distributed. Empirical studies by Newbold, Carlsson and Thorne (2003) have shown that samples with $n \geq 20$ are sufficient.

Where $\widehat{\alpha}_1$ is the coefficient estimator, $s_{\widehat{\alpha}_1}$ is its standard error, n is the number of observations and α is the significance level.

In order to find the lowest significance level at which the null hypothesis can be rejected, a *p*-value can be derived from the Student's t distribution table. When performing the OLS in Microsoft Excel 2007, the *p*-value is obtained directly from the regression output.

The fact that size can explain risk adjusted return does not, however, tell us that it is size, *per se*, that is affecting risk adjusted return; the cross-sectional development in risk adjusted returns might instead depend on another variable, closely related to size. Therefore, several *multiple regressions*[21] with risk adjusted return as the dependent variable and size, D/P and M/B as independent variables, were conducted.

The regressions were performed in three main stages (see table 4). When the regression for risk adjusted return and size has been conducted (regression 1A), two additional regressions were produced by adding D/P and M/B respectively as additional explanatory factors besides MC (regressions 2A and 2B). Subsequently, one more regression in which all three independent variables are present, was conducted (regression 3A).

Table 4: Three stages of regressions

Stage	1	2				3		
Sub-stage	A	A		B		A		
Explanatory variable(s)	Size	Size	Dividend yield	Size	Market-to-book	Size	Dividend yield	Market-to-book

For each stage, the *p*-value for the corresponding independent variable's coefficient, as well as the *coefficient of determination*, R^2, will be analyzed. R^2 provides a descriptive measure of the proportion or percentage of the total variability that is explained by the regression model[22]. In other words, it provides a measure of the *goodness of fit* of the regression equation. For completeness, the standard error of the coefficient, the value of the constant and its *p*-value, will also be presented.

As additional independent variables are added to a multiple regression model, the SSR (variance explained by regression function) will increase even if the added variable is not important as a predictor. Therefore, the coefficient of determination, R^2, will be misleading in these situations. To avoid this problem, the *adjusted* coefficient of determination $\bar{R}^2$ will be used when analyzing the explanatory power provided by additional independent variables[23].

[21] Multiple regressions include several independent variables instead of just one. The procedure through which a multiple regression is conducted, and related hypotheses tested, is similar to that for simple regression. As explained by Newbold, Carlsson and Thorne (2003), a simple regression is merely a special case of a multiple regression with only one predictor variable.

[22] $R^2 = \frac{SSR}{SST} = 1 - \frac{SSE}{SST}$ For descriptions, see note 16.

This quantity varies from 0 to 1, and higher values indicate a better regression, all else equal. Thus, we see that R^2, can be large either because SSE is small (indicating that the observed points are close to the predicted points and thereby that the estimated line of best fit is good) or because SST is large. This implies that R^2 can only be used to compare regression models that have the same SST, which often requires the same set of sample observations.

[23] $\bar{R}^2 = 1 - \frac{SSE/(n-K-1)}{SST/(n-1)}$, where n is the number of observations and K is the number of independent variables.

2.4 Validity and reliability

Validity, in a statistical context, refers to whether or not the methodology used is relevant for describing the issue at hand, while reliability concerns the trustworthiness of the data used[24]. In other words, validity refers to doing the right things whilst reliability refers to doing things right.

In order to ensure the validity of our study, a large number of published articles on the subject have been studied. By comparing our method to those used by renowned researchers, we ensure that the study is conducted in line with common perception. For example, the decision of the length of the studied period, the construction of 25 size portfolios, using the base ten logarithm (log) of MC and the reinvestment of dividends are in line with prior research[25].

For this study, MC was used as a proxy for size. Although this has been standard practice for similar research (see 3 Literature review), it is not the only choice. For example, a company's sales could have been used instead of MC to represent size. Had we used sales instead of MC, the results of this paper could have been very different.

This study is based on raw data which has not been subjectively altered in any way. Many other papers modify the sample for various reasons. The sample used for this paper, however, includes all companies listed on the Stockholm Stock Exchange during the research period. Although the sample has been left untouched, the return data used for this study is adjusted to better reflect share development. For example, return is not only adjusted for dividends but also for splits and dilution (caused e.g. by issuing equity to a price below current market price). In addition, individual stock returns that deviate more that 5 standard deviations from the total sample have been excluded for the year in question in order to prevent a single observation from disproportionately altering the sample.

Since this paper uses return data for all companies that are or have been listed on the Swedish stock market during the period in question, it includes the returns for companies that have been delisted and is hence unaffected by survivorship bias.

When a share is delisted for whatever reason, the yearly return for that share will be incomplete since it will not show the return for the entire year, but rather just the return up to the point of delisting. This is an issue for which we have found no efficient means of adjustment. However, we do not have any reason to believe that these delistings should be related to size, which means that this issue does not necessarily bias the data used for this study.

Data supplied by Datastream is considered highly reliable. Nonetheless, crosschecks against other sources such as OMX[26] were continuously performed in order to further validate the quality of the data. With such a foundation as base, the reliability of the study cannot be considered low.

Another issue concerning the validity of the study is related to the second part of our research question, i.e. establishing a mathematical relationship between firm size and risk adjusted return (in order to assist practitioners in the process of performing valuations). In essence, it consists of MC being the final result of a valuation as well as a component in the valuation toolkit. In other words, we have a "catch 22" problem; the MC is needed in order to estimate the value of the

[24] Holme and Solvang (1997)

[25] 25 portfolios: Banz 1981, 20 year research period: Lakonishok and Shapiro (1983), Dividends reinvested and Log of MC: Grabowski and King (2008), Brown, Kleidon and Marsh (1983)

[26] See www.omxnordicexchange.com

company. However, practitioners of corporate valuation often perform a valuation using multiples before conducting a DCF valuation. This gives a rough estimation of the value of the company, e.g. a range of between MSEK 500 and MSEK 800. With this information, it is possible to estimate an initial SP and through an iterative process similar to the one employed when estimating the WACC[27], find a more appropriate figure for the value of owners' equity.

2.5 Sources

In order to place this study within its proper context, the literature review presented in the next chapter illustrates the history of the size effect from a world-wide perspective. Both books and published papers from acknowledged academic journals containing research on the size effect are covered.

In addition, an interview was conducted with Gabriel Urwitz (Urwitz 2009-03-05), chairman of the private equity firm Segulah Advisory AB[28]. This was done in order to obtain a deeper understanding on how the size effect is handled in practice. He argues that a larger Re should be applied to small companies primarily due to the illiquidity of their shares and the fact that owners are often less diversified. These factors are particularly accentuated for small, *private*, firms. When analyzing potential acquisition candidates, standard procedure at Segulah is to add approximately 5% to the required return on equity.

[27] Since the market value of owners' equity is a part of the WACC formula, practitioners need to pursue an iterative procedure to calculate the correct value of owners' equity.

[28] See www.segulah.se for further description of the business

3 Literature review

In the following chapter, previous research conducted on the size effect and on other topics that are of interest to the purpose of this thesis are presented based on the decade in which the research was published. Some of the research findings presented here will also be used as a theoretical framework for the analysis of our empirical results.

3.1 The 1980s

It all starts in 1981, when Banz provides the first empirical evidence of a size effect. He had studied the development of risk adjusted returns for all common stocks quoted on the New York Stock Exchange (NYSE) during the period 1931 to 1975 and found that the risk adjusted yearly returns of small companies, on average over the period, were 4.9% higher than for large companies. This finding, that not only suggests that one of the cornerstones in financial theory, the CAPM model, is misspecified, but also indicates an anomaly that could be used by investors to generate arbitrage gains, sets off an avalanche of research. Some academics try to find a relationship between risk adjusted return and other measurable parameters while others focus on trying to find the "underlying reason" for the size effect. None, however, succeed in providing a reasonable explanation.

3.1.1 The Discovery

A widespread view among academics is that the size effect was first documented by Banz (1981) in a study where he examines the development of risk adjusted returns for all common stocks quoted on the New York Stock Exchange (NYSE) during the period 1931 to 1975. The evidence presented in Banz's study suggests that CAPM is misspecified; "On average, small NYSE firms have had significantly larger risk adjusted returns than large NYSE firms over the 40 year period". By constructing 25 size based portfolios, which are rebalanced on a yearly basis, he reaches the conclusion that the yearly risk adjusted returns of small companies are on average 4.9% higher than for large companies over the period[29]. Banz (1981) concludes by questioning whether it is size per se that is responsible for the size effect, or if size is merely a proxy for one or more *true* factors correlated with size.

Reinganum (1981) delves further into the relationship between risk adjusted return and size, as well as the earnings/price ratio (E/P) on NYSE stocks, for the period 1963-1979. Both factors in Reinganum's (1981) study show significant explanatory power related to risk adjusted return when each variable is considered separately. However, the data also reveals that "an E/P effect does not emerge after returns are controlled for the firm size effect." The study by Reinganum (1981) therefore supports the work of Banz (1981) by strengthening the empirical evidence for a relationship between risk adjusted return and MC.

3.1.2 Beta estimation

Roll (1981) later argues that the high degree of infrequent trading in the shares of small firms could serve as reason for the discovered size premium. Infrequent trade biases the assessment of the beta risk factor downwards, resulting in a lower expected return (see 5.3.5 Infrequent trade for a more detailed explanation). A lower expected return for small firm stocks would, everything else being equal, result in higher risk adjusted returns for small firm stocks. However, Roll (1981) concludes that the bias in risk estimates due to infrequent trading cannot explain the magnitude of the risk adjusted average returns, found by Banz (1981) and Reinganum (1981).

[29] Calculated from a monthly size effect of 0.4%

3.1.3 The January effect

Keim (1983) discovers a seasonal behavior of average risk adjusted returns for the period 1963-1979, by showing that the relation between risk adjusted returns and size is more pronounced and *always* negative in January, compared to any other month. Reinganum (1983) suggests that the reason for this identified "January effect" is tax-loss selling at year ends. As investors at year end sell "bad-performing" stocks to realize tax-deductible capital losses, stock prices face further downward pressure. In the beginning of the subsequent year, prices revert to fair values and create a January return boom. As argued by Roll (1983), companies whose stock prices have fallen during the year are smaller, by the definition of MC, at year end than in the beginning of the year. Hence, it is not surprising that the January effect is more pronounced for small-sized firms.

3.1.4 Neglected firm effect

Another explanation to the appearance of the size effect was presented in the early 1980s. The explanation was labeled the "neglected firm effect" and was first discovered by Arbel and Strebel (1982). Their research shows that small firms are neglected to a greater extent than large firms, when neglect is defined as lacking analyst coverage. According to their study, stocks of neglected firms provide, on average, higher risk adjusted returns than other stocks. This neglected firm effect is also confirmed by Arbel, Carvell and Strebel (1983) who conclude that small firms are generally unsuited to the investment requirements of financial institutions and hence attract minimal analyst coverage. Their empirical research, based on an analysis of 510 firms during the period 1971-1980, indicates that the shares of those firms neglected by institutions significantly outperform the shares of firms widely held by institutions. According to Carvell and Strebel (1987), the neglected firm effect is independent of, and in fact may dominate, the size effect. They claim that neglected firms offer risk adjusted returns due to their higher level of information uncertainty. Hence, investors are compensated for the relative lack of information about small firms' future returns.

3.1.5 Illiquidity and transaction costs

Stoll and Whaley (1983) argue that transaction costs in the financial markets could constitute a possible explanation for the size effect discovered by Banz (1981), since CAPM assumes a friction-free financial market without the presence of any transaction costs. They show that the explicit cost associated with trading a stock is inversely proportional to firm size. However, Schultz (1983) shows that small firm portfolios earn excess risk adjusted returns even net of transaction costs for long and short holding periods and hence conclude that these returns cannot solely be explained by differences in transaction costs. Despite the evidence presented by Schultz (1983), Amihud and Mendelsohn (1986) continue down the transaction costs path and advocate that the transaction costs associated with trading an asset are higher for less liquid assets, and that small firm stocks typically suffer from market "thinness" which impairs their liquidity. Therefore, they suggest that small firm stocks should earn risk adjusted returns, and hence, that an illiquidity premium, due to relatively higher transaction costs, could explain the premium returns experienced by small firm stocks.

3.1.6 Dividend yield

Elton, Gruber and Rentzler (1983) were not pioneers in their examination of the empirical impact dividend yields might have on security returns. Still, unlike many of their predecessors, their study was conducted *after* Banz (1981). In their research, Elton, Gruber and Rentzler (1983) find the association between high positive risk adjusted return and zero dividend stocks to be statistically significant. The authors discuss whether the dividend yields *per se* are accountable for these risk adjusted returns, or if there might be an alternative explanation for this discovery. The most obvious explanation, the authors argue, is that it is due to a small firm effect. As quoted, "small firms make up a much higher proportion of zero dividend stocks than they do of other groups and a number of authors have found that small firms on average have positive risk adjusted returns". Yet the authors do not provide any further evidence of a small firm effect in their study.

3.2 The 1990s

In the beginning of the decade, Fama and French take a different approach on tackling the size effect mystery. Instead of continuing the hunt for the explanation of the size effect they question the predictability of the CAPM model. They discover that the relation between beta and average return has not been present over the previous 30 years. However, this direct assault on the CAPM model instantly receives substantial criticism. In 1999, Dimson and Marsh discover a striking new phenomenon; since the publication of Banz (1981), the size premiums of old had turned into size discounts!

3.2.1 Market to book

Fama and French (1992) take on a different approach and instead of continuing the hunt for the explanation of the size effect, they question the predictability of the CAPM model. They discover that the relation between beta and average return virtually disappears during the period 1963-1990, and that the relation is weak over the 50-year period 1941-1990. Instead, size and the market to book ratio (M/B) appear to have larger explanatory power in describing the cross-section of average raw stock returns than beta. Their findings received much attention when they were published, largely because it casts serious doubt over the CAPM model. Black (1993), however, is critical of the empirical result of Fama and French (1992) and claims that they are misinterpreting their own data. He states that "during 1981-1990 they find no size effect at all, whether or not they control for beta. Yet they claim that size is one of the variables that 'capture' the cross-sectional variation in average stock returns". Also, he argues that Fama and French (1992) do not provide any explanations for a relation between size and expected return; they just ascertain that it exists. Black (1993) suggests that most of the Fama and French (1992) results are attributable to what he labels "data mining"; that is, when a researcher tries so many ways to conduct research, using various combinations of explanatory variables, that in the end all the results that seem significant could just be accidental. In fact, Black (1993) states that most of the previously discovered anomalies in financial market studies are likely to be the result of this excessive use of explanatory research variables.

3.2.2 Marginal firms

In their attempt to explain the size effect, Chan and Chen (1991) examine differences in structural characteristics that lead firms of different sizes to react differently to the same economic news. They state that small firms examined in the empirical literature tend to possess the characteristics of what they label "marginal firms". These types of firms lose market value due to poor performance in terms of inefficient production, cash flow problems, in combination with high financial leverage, and tend therefore to be riskier than other firms. As quoted in Chan and Chen (1991), "these companies are marginal in the sense that their prices tend to be more sensitive to changes in the economy, and they are less likely to survive adverse economic conditions". Their research shows that the time series of the return difference between small and large firms can be captured by the responses of marginal firms to economic news. They conclude that the size proxy does not possess any explanatory power after controlling for the marginal firm characteristics.

3.2.3 Size discount

At the end of the decade, Dimson and Marsh (1999) reported a change in the earlier documented size premium of small firm stocks, using data for both the UK and US stock markets. Calculated as the difference in raw returns between the smallest and the largest size deciles, UK small cap stocks experienced an annual size premium of 5.9 % between 1955 and 1988, while the corresponding number for US small stocks was 4.1%, for the period 1955-1983. However, after the end of each respective period (1988 in UK and 1983 in US) until 1997, the size premium went into reversal in both countries. The UK and US firms experienced a negative premium of -5.6% and -2.4% respectively. This *size discount* persists even after risk-adjustment. The authors find that the previous outperformance of small firm stocks in the UK and US coincided with superior dividend growth for small firms. In contrast, the reversal of the size premium coincided with inferior dividend growth for small firms, implying that the relative change in dividend growth could serve as an explanation for the changing size effect. Dimson and Marsh (1999) conclude by stating that the size effect lives on since small firms continue to perform differently than large firms, but it is important to distinguish between the terms "size effect" and "size premium" (i.e. a positive size effect).

3.3 The 2000s

Thanks to a paper consolidating research on the size effect in many different countries, the world-wide existence of this phenomenon is now confirmed. The research of the new millennium continues to provide support for a size discount during the period subsequent to the discovery of the size effect. However, in 2006, researchers found that returns for the most recent years has been larger for small stocks than for large, which signals a resurrection of the size premium.

3.3.1 Further evidence for a size discount

After the publication of Dimson and Marsh (1999), academic research continued to discover a reversal of the size premium after the publication of Banz (1981). Horowitz, Loughran and Savin (2000) initially find that investors could have earned a large raw size premium (almost 13.0% per year) during the period 1963-1981, had they invested in small firm stocks instead of large. However, between 1982-1997 the raw size premium turns into a yearly raw size discount of 2.0%, as firms in the smallest size decile on the NYSE, AMEX and Nasdaq average 1.3% per month compared to 1.46% for firms in the largest size decile. Horowitz, Loughran and Savin (2000) argue that a possible reason for the diminishing raw size effect could be that as investors became more aware of the effect, small firm prices increased (thus lowering subsequent raw returns).

When examining a range of commonly discussed market anomalies, Schwert (2003) finds that the size effect seems to have disappeared after the papers that highlighted them (Banz (1981) and Reinganum (1981)) were published. For the period 1982-1997, risk adjusted monthly returns for small firm stocks range between -0.2 and 0.4, which is substantially lower than during the period examined in the initial publications. Ibbotson Associates (2003) study the risk adjusted size premium for US stocks over the period 1926-2002 for 10 size based portfolios (deciles). Over the whole period, the risk adjusted size premium for the smallest stocks (smallest decile) is 5.67%. However, since the publication of Banz (1981) they discover a raw size discount of 2.8% for the smallest size decile compared to the largest[30]. Until the discovery of the size effect, between 1926 and 1981, the raw size premium was 6.2%.[31] Al-Rjoub, Varela and Hassan (2005) also discover a risk adjusted size effect reversal in the US, over the period 1970-1999. They argue that since small firms now trade more frequently than before, risk measures for small-firms previously considered misspecified by Roll (1981) are now corrected, resulting in a transition from size premiums towards size discounts.

3.3.2 Economic cycles

Kim and Burnie (2002) investigate the hypothesis that the small firm effect is driven by the economic cycle, for American stocks during the period of 1976 to 1995. They argue that in periods of economic expansion small firms generate large abnormal profits; however, in periods of economic contraction no significant firm size effect is evident. As expressed in Chan and Chen (1991), the logic behind this hypothesis is that most small firms are characterized by low productivity and high financial leverage and usually grow faster than large firms in good economic conditions and vice versa in bad economic conditions. The result of Kim and Burnie (2002) confirms this hypothesis: "the small firm effect occurs in the expansion phase of the economic cycle".

3.3.3 The size effect world-wide

Following the discovery of a size premium on the US equity markets by Banz (1981), researchers began investigating its existence in other stock markets around the world. Although many studies were performed world-wide during the previous two decades, Hawawini and Keim (2000) summarize this research for 17 different countries. In each country, the monthly raw size premium is defined as the difference between the average monthly return on the portfolio of smallest stocks and the average monthly return on the portfolio of largest stocks. They find that there is a significant negative relationship between returns and portfolio size in all countries, except Canada and France. Appendix 1 shows the raw size premium for all countries[32]. As can be seen from this chart, the raw size premium varies significantly across markets. It is most pronounced in Mexico (4.16%) and least significant in Singapore (0.41%). Korea is the only country where the size premium is negative (- 0.40%) during the sample period. Dimson, Marsh and Staunton (2002) continue the research conducted by Hawawini and Keim (2000), but for the period subsequent to the initial publication of the size effect. As seen in appendix 1, 18 of the 19 studied countries experienced raw size discounts[33] in the subsequent period. For the only country experiencing a raw size premium (Switzerland), the result is statistically insignificant. Even though the raw size premium is measured as the non-risk adjusted difference between the returns on a small-cap index and a large-cap index, the indices across countries sometimes define small-cap slightly differently, and the time period covered by each study varies enormously, which implies that the results are not *directly* comparable. In addition, as mentioned above, Dimson, Marsh and Staunton (2002) does not investigate if the return differences remain after risk adjustment, i.e. adjustment for beta. Yet, from this research it becomes evident that the previously identified raw size discount on US small firm stocks may in fact be a world-wide phenomenon.

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[30] Calculated based on year end index values of total returns in Ibbotson Associates (2003)
[31] Ibid
[32] For US and UK, the Banz (1981) and Dimson, Marsh and Staunton (1987) studies are reported respectively, instead of those reported by Hawawini and Keim in order for the Dimson, Marsh and Staunton (2002) subsequent period study to match the initial publication date in all countries. The size premium in US and UK. are thereby risk adjusted, i.e. the size premium (not the raw size premium) is presented.
[33] Size discounts (not raw size discounts) for US and UK.

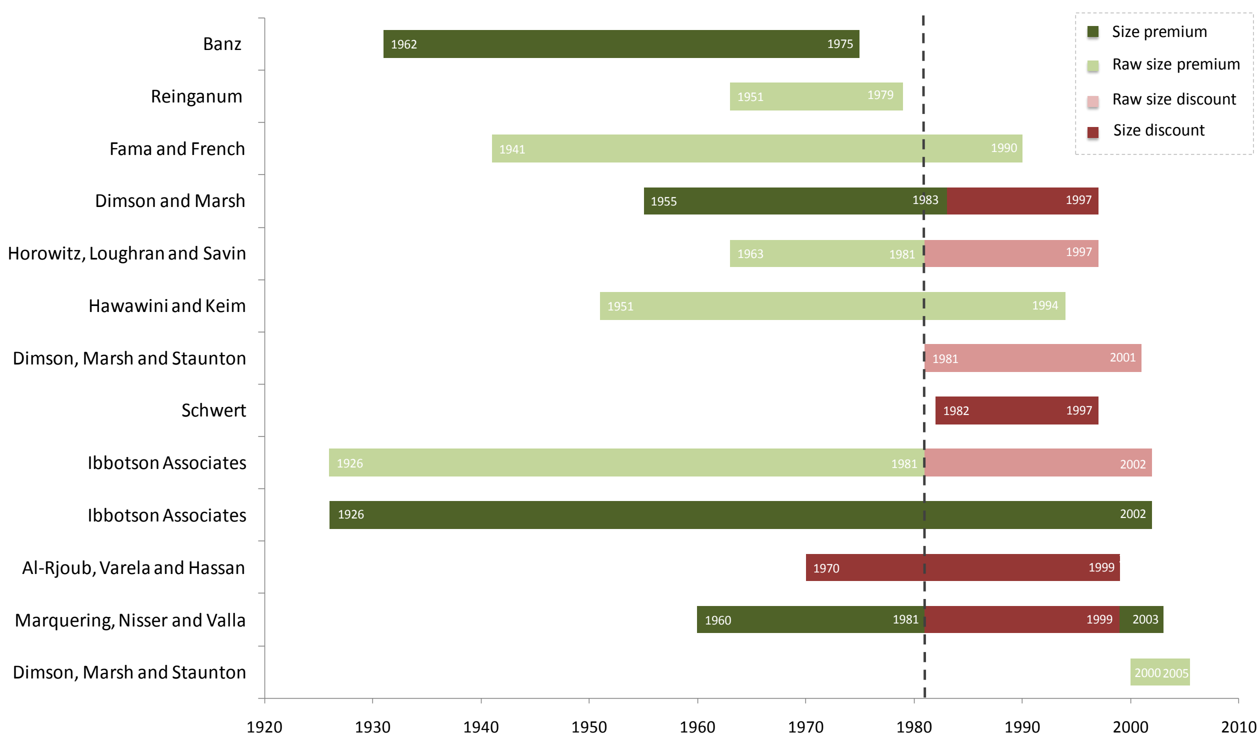
3.3.4 The resurrection of the size premium

Marquering, Nisser and Valla (2006) discover that the size effect after going into reverse, as documented by Dimson, Marsh and Staunton (2002), seems to have reappeared for the period 1999-2003. Marquering, Nisser and Valla (2006) find that between 1960 and 1981 the average yearly risk adjusted return amounted to 1.5% [34], using US stock data. From 1982 to 2003, the return difference between large and small firms decreased substantially and was no longer significant. However, for the period 1999-2003, they discover an average yearly risk adjusted return of 2.2%[35] for small firm stocks, which signals a resurrection of the size premium. This discovery is also confirmed by Dimson, Marsh and Staunton (2006), who examine the size effect in 16 countries for the period 2000-2005. For almost all countries the raw size premium is defined as the difference in raw returns between the MSCI small-cap index (company sizes ranging from 200 MUSD and 1500 MUSD) and the MSCI standard country index. 15 of the 16 countries studied experienced a yearly geometric average raw size premium for the studied period, ranging from 3.0% to 17.0%. Even though the geometric average size premium is not fully comparable with the more commonly used arithmetic average size premium, the Dimson, Marsh and Staunton (2006) result nevertheless strengthens the conclusion that the size premium, during the most recent years, has returned.

3.4 Summary and implications

Over time, researchers have discovered size premiums (higher risk adjusted returns for small firms) as well as size discounts (higher risk adjusted returns for large firms), even when controlling for beta risk. Chart 1 presents the evolution of the size effect showing both periods in which size has been related with a return premium (green) as well as periods in which size has been related with a return discount (red).

Chart 1:The size effect over time



[34] Based on monthly returns of 0.12%
[35] Based on monthly returns of 0.18%

After the breakthrough discovery of Banz (1981), research consistently shows a clear change in the direction of the size effect. It appears that investors are made aware of the alleged mispricing on the market and acted upon this information by buying the supposedly undervalued shares. As a consequence, the returns of these shares dropped, which, judging by the research presented by the authors mentioned above, gave birth to a new era of the size effect; the period of size discounts. However, research covering the most recent period indicates that the direction of the size effect may once again have turned.

In the context of corporate valuation, the impact of the size effect is big. The fickle nature of this phenomenon makes it even more important to get things right. We have chosen to analyze the size effect using data for the past 20 years since we do not believe that practitioners are interested in knowing whether or not the size effect existed during a particular period in time. What is interesting from the practitioners' point of view is rather to know if valuations *today* should take this factor into consideration or not. This is why we choose not to divide the studied period into sub-periods, but rather focus on the stronger potential evidence for the size effect that can be provided from a single, longer, period.

As has been shown above, the size effect phenomenon has been extensively investigated during the last three decades. Whilst many researchers have been able to prove the existence of the size effect using different statistical techniques and periods, others have focused on explaining why this phenomenon has appeared on the world's stock markets. For completeness, a table summarizing all the above mentioned papers, including research focusing on both the existence of the size effect as well as the reasons for its existence, can be found in appendix 2.

4 Results of the empirical study

In the following chapter, the results from the different statistical tests conducted will be presented. The chapter begins with describing the data gathered on the 25 portfolios and goes on to present the results of the regression analysis, and finally presents a robustness test.

4.1 Portfolio characteristics

As seen in appendix 3, the average size of the portfolios is not constant over time. The average size of the smallest portfolios is quite similar in 2007 to 1988 (the average company size in portfolio 1 to 6 have actually decreased) while the average size of the largest portfolio has grown with approximately 11.6 times, from MSEK 14 436 to MSEK 167 157. In other words, the smallest companies are about as small today as they were in 1988, if not smaller, while the largest have become substantially larger. The average size of the portfolios over the entire 20 year period range from MSEK 10 (for portfolio 1) to MSEK 78 469 (for portfolio 25).

Average raw return over time for the portfolios ranges from 10.3% for portfolio 17 to 34.3% for portfolio 10. The spread in raw return, between the highest and the lowest yearly observation, is high for the smallest companies. However, the largest spread, 365.2%, is within portfolio 10. A negative relationship between portfolio average size and raw return can be observed in the sample. This relationship will, however, not be examined further since the purpose of this paper is to analyze the relationship between size and risk adjusted return, not raw return.

Average portfolio risk adjusted returns, defined as the return in excess of CAPM (see [2] for a complete definition), range from 17.6% for portfolio 1, to -4.3% for portfolio 17. The estimated beta values are rather low, ranging from 0.3 for portfolio 3 to 0.9 for portfolio 25. As stated in section 2.2.2 CAPM and beta estimation, due to the weekly observation interval used in this study the beta values are consistently underestimated, which explains the low estimated values. Portfolio 10 has the largest spread between minimum and maximum risk adjusted return, 255.8%, over the 20 year period. As seen in appendix 3, a negative relationship between portfolio average size and risk adjusted return, can be observed in the sample.

4.2 Regression analysis

4.2.1 Stage 1: MC

As a first step in presenting the results concerning the explanatory power of size for risk adjusted return, table 5 summarizes the output of the first return regression: MC vs. risk adjusted return.

Table 5: Stage 1:Risk adjusted return regression vs. MC

Stages	Sub-stage	Explanatory variable	Coefficient	*P*-value for coefficient	Std error for coefficient	Constant	*P*-value for Constant	R^2
1	A	Size	-3,32	0,0028	0,99	12,95	0,0001	32,8%

The R^2 of 32.8% indicates that 32.8% of the variability in the dependent variable is explained by the regression equation, which is an acceptable value for a single parameter in an OLS regression[36].

[36] For comparison with a similar study, see Lakonishok and Shapiro (1986)

The *p*-value of 0.0028 indicates that the probability of obtaining a result at least as extreme as the one that was actually observed, assuming that the null hypothesis is true, is 0.28%. Thus, the conditional hypothesis (H_0) that this coefficient is equal to zero (i.e. that risk adjusted return cannot be explained by size) can be rejected on a 5% significance level. The coefficient is -3.32% with a standard error of 0.99%. Size is denoted as the log of market capitalization in MSEK. This implies that as the log of MC increases by 1, the SP decreases with 3.32%.

The estimated coefficient ($\widehat{\propto}_1$) and the estimated constant ($\widehat{\propto}_0$) resulting from minimizing SSE in the regression equation using the OLS method, are presented below:

$\widehat{\propto}_1$ = -3.32%

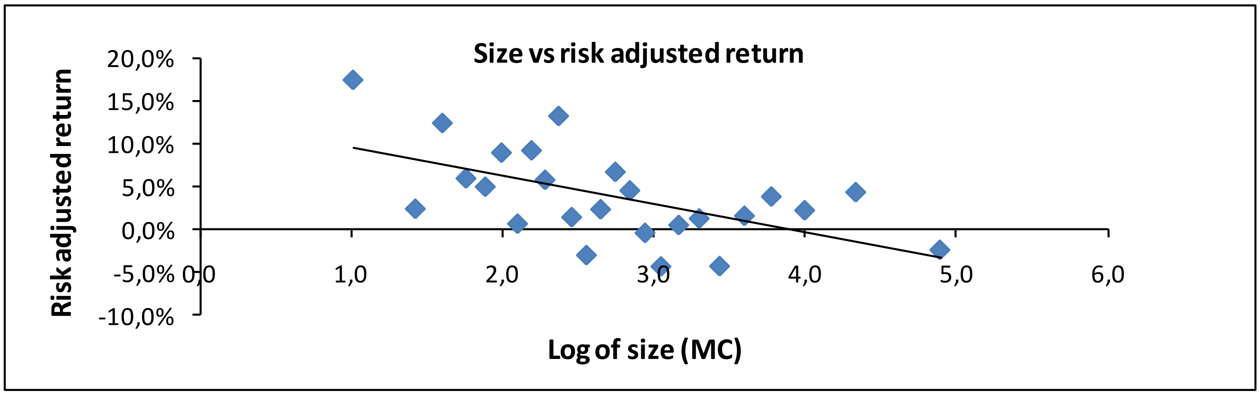
$\widehat{\propto}_0$ = 12.95%

The line of best fit can hence be expressed by [5]:

[5] $$\widehat{SP}_i = 12.95\% - 3.32\% \times log(MC_i)$$

This formula provides an approximation of the SP for a company with any given MC. The line of best fit in chart 2 visualizes this relationship:

Chart 2: Size vs. risk adjusted return



As a complement to [5] displayed above, the results obtained from this study can be presented in a similar fashion to the study by PwC (2009) in order to increase comparability between the two studies. By applying [5] on the selected firm size, a SP is obtained. For example, a company with a MC of MSEK 100 is expected to have a SP of 6.3%.

Table 6: SP for selected MCs

Firm size (MC)	Size premium
MSEK 5000	0,7%
MSEK 2000	2,0%
MSEK 500	4,0%
MSEK 100	6,3%

4.2.2 Stage 2: MC - D/P and MC - M/B

In stage 2, MC together with D/P and MC together with M/B were used as independent variables in two separate regressions. These are presented as 2A and 2B in table 7.

Table 7: Stage 2: Risk adjusted return vs. MC & M/B and risk adjusted return vs. MC & D/P

Stages	Sub-stage	Explanatory variable	Coefficient	*P*-value for coefficient	Std error for coefficient	Constant	*P*-value for Constant	R^{2*}
1	A	Size	-3,32	0,0028	0,99	12,95	0,0001	32,8%
2	A	Size	-1,28	0,5149	1,94	15,13	0,0002	31,3%
		Dividend yield	-3,71	0,2363	3,04			
	B	Size	-2,40	0,1480	1,60	13,56	0,0002	28,5%
		Market-to-book	-1,20	0,4693	1,63			

* Ajusted R^2 for regression 2A, 2B and 3A

In both 2A and 2B, $\bar{R}^2$ is lower than R^2 in 1A: 31.32% and 28.46% respectively compared to 32.8%. This implies that the goodness of fit in 1A is superior in 1A than in both 2A and 2B. In other words, neither the addition of D/P nor M/B creates a line of best fit which produces estimates of the SP that are closer to the observed values, than MC alone.

The addition of an additional variable does, however, have a considerable impact on the *p*-value of MC. In 2A, the *p*-value of MC increases from 0.28% to 51.49%. In 2B, the *p*-value of MC increases to 14.80%. The increase in the *p*-values of MC in both regressions impedes the rejection of the null hypothesis, i.e. we cannot rule out that risk adjusted return cannot be explained by size. In both multiple regressions, size as an explanatory variable for risk adjusted return, is subsumed by the other factor. In other words, dividend yield and market to book provide so much explanatory power that we cannot rule out that size does not explain risk adjusted return.

4.2.3 Stage 3: MC - D/P - M/B

For completeness, a regression with all three dependent variables, MC, D/P and M/B was conducted (regression 3A). This regression reached an $\bar{\mathrm{R}}^2$ of 28.69% which is a decrease from 2A (31.32%) but an increase from 2B (28.46%). In comparison to 1A (32.8%.), 3A has a lower goodness of fit. In addition, the p-values of all independent variables increase substantially from stage 2 which means that it cannot be ruled out that any of the independent variables do not explain risk adjusted return.

Table 8: Stage 3: Risk adjusted return vs. MC, D/P & M/B

Stages	Sub-stage	Explanatory variable	Coefficient	*P*-value for coefficient	Std error for coefficient	Constant	*P*-value for Constant	R^{2*}
1	A	Size	-3,32	0,0028	0,99	12,95	0,0001	32,8%
2	A	Size	-1,28	0,5149	1,94	15,13	0,0002	31,3%
		Dividend yield	-3,71	0,2363	3,04			
	B	Size	-2,40	0,1480	1,60	13,56	0,0002	28,5%
		Market-to-book	-1,20	0,4693	1,63			
3	A	Size	-0,93	0,6692	2,14	15,28	0,0002	28,7%
		Dividend yield	-3,33	0,3122	3,22			
		Market-to-book	-0,73	0,6689	1,69			

* Ajusted R^2 for regression 2A, 2B and 3A

4.3 Robustness test

The robustness of the result was tested by altering three parameters used in the research. First, the number of size based portfolios in which the companies were divided into each year was changed. 25 portfolios were initially chosen since this number was used in research with a similar focus to this paper. Since increasing the number of portfolios would have resulted in too few companies per portfolio, the number was reduced from 25 to 15. Second, the return observations used to establish the beta values for each company each year was altered. As mentioned in section 2.2.2 CAPM and beta estimation, opinions on how to most accurately estimate beta vary. There is a trade-off between a long enough estimation period to decrease the standard error for the beta estimate, and a short enough period so that the company characteristics have not been significantly altered. 36 monthly observations (three years) constitutes a longer estimation period than 104 weekly observations (the two years that was chosen for the study), but reducing the interval to 24 monthly observations (two years) would most likely not yield an adequate estimate of beta. Therefore, tests with 36 monthly observations were added to the robustness test. Finally, the time period of 20 years was split into two ten-year periods to test robustness over time.

After altering these variables, new t tests were conducted to check whether a significant relationship between risk adjusted return and MC would still be present. The result of the robustness test is presented in table 9. Those tests which provided significant evidence (on a 5% significance level) of a relationship between risk adjusted return and MC are all highlighted with light green. The result of the initial test using 25 portfolios and beta values based on 104 weekly observations during the period 1988-2007, is presented furthest to the right in the table, highlighted in dark green.

Table 9: Robustness test

Robustness test	15 portfolios[1]						25 portfolios[1]					
	36 monthly observations[2]			104 weekly observations[2]			36 monthly observations[2]			104 weekly observations[2]		
Statistic	1988-1997	1998-2007	1988-2007	1988-1997	1998-2007	1988-2007	1988-1997	1998-2007	1988-2007	1988-1997	1998-2007	1988-2007
R^2	31,90%	1,44%	18,03%	47,90%	0,58%	42,58%	20,29%	0,51%	12,02%	34,40%	0,88%	32,80%
X coefficient	-5,06	0,54	-2,03	-6,82	-0,29	-3,29	-4,98	0,38	-2,11	-6,66	-0,43	-3,32
Standard Error (for X coefficient)	2,05	1,24	1,20	1,97	1,07	1,07	2,06	1,09	1,19	1,92	0,94	0,99
P-value (for X coefficient)	2,83%	67,03%	11,47%	0,40%	78,80%	0,84%	2,39%	73,33%	8,96%	0,20%	65,39%	0,28%
Constant	15,16	0,43	7,20	22,90	3,66	12,60	15,28	1,16	7,72	22,78	4,28	12,95
P-value (for Constant)	2,28%	90,64%	5,88%	0,14%	26,14%	0,13%	1,61%	71,93%	3,45%	0,04%	12,89%	0,01%

[1] The number of portfolios used for dividing the companies in descending size (MC) each year

[2] The number of return observations per company used to estimate that company's beta value, for a specific year

As can be seen in table 6, the tests using 15 portfolios as well as the tests using 25 portfolios both yield three significant relationships, and three non-significant relationships. The three significant results obtained for both groups relate to the same time periods, regardless of beta estimation technique[37]. The results of the study can hence be regarded as unaffected by changing the number of portfolios from 25 to 15.

It appears as though the tests in which beta is based on 104 weekly observations in general, provide stronger evidence of a size effect than when beta is based on 36 monthly observations. The tests using 104 weekly observations generate significant results for both the first ten years of the sample (1988-1997), and the total 20 year period (1988-2007) while tests using 36 monthly observations only generate significant results for the first ten years. The results from the study can hence not be regarded as unaffected by beta estimation technique.

From table 6 it is also clear that the relationship between risk adjusted return and MC appears to be strongest during the first ten years of the sample period (1988-1997). The result obtained during this period is significant throughout the entire test, regardless of the number of portfolios used as well as beta estimation technique. In addition, the slope of the coefficient is consistently steeper during this sub-period than during the entire 20 year period, which signals a more pronounced size effect during the first ten-year period. In contrast, no combinations of parameters yield a significant relationship for the subsequent period, 1998-2007. Based on the coefficients for the years 1998-2007, it could be argued that the size effect went in reversal during the latter part of the 20 year research period. The results from the study can hence not be regarded as unaffected by the chosen time period.

It should, however be noted that the largest *p*-value for tests conducted on the whole 20 year period is 11.47%, which is above the 5% level but close enough to merit attention. For the 20 year period the relationship between MC and risk adjusted return can therefore be considered strong.

To summarize, the results of this study remain significant on a 5% level after changing to 15 portfolios. If the time period of 20 years is split into two ten year periods, the *p*-value increases to above 5% for the period 1998-2007. In addition, if beta estimation method is altered, the significance only remains strong enough in the first period.

[37] 1988-1997 for 36 monthly beta observations, 1988-1997 for 104 weekly beta observations, and 1988-2007 for 104 weekly beta observations.

5 Analysis

This chapter begins with an analysis of the results reached in the previous chapter. Initially the question of whether a size effect exists is analyzed and thereafter, the results regarding its magnitude are discussed. Finally, theoretical explanations for the size effect are presented.

5.1 The existence of the size effect

Part of the purpose of this study is to determine whether or not a size premium is empirically justified or not on the Swedish stock market. The results presented in the previous chapter support the case for applying a size related premium to the required return on equity, Re, when valuing small firms. These results are, of course, contingent upon the application of the methodology presented in chapter 2 Methodology. However, as described in section 4.3 Robustness test, some parameters can be altered without substantially affecting the results.

As noted in the previous chapter, there is a strong link between the M/B and D/P ratios, and MC in their ability to predict risk adjusted returns. This is shown as the ability of both D/P and M/B to significantly alter the *p*-value of MC as an explanatory variable. In fact, the explanatory power of D/P to risk adjusted returns appear to be stronger than that of MC in the multiple regression as the *p*-value for the coefficient is lower for D/P than MC. This result is not surprising considering previous research conducted on Swedish data. Among others, Skogsvik and Skogsvik (2005) discovered a significant relationship between D/P and risk adjusted returns on Swedish empirical data. However, as noted by Elton, Gruber and Rentzler (1983), dividend yield might just be a proxy for size and therefore less relevant as an explanatory variable. In any case, the fact that D/P and M/B also possess explanatory power of risk adjusted return does not make MC any less interesting as an explanatory variable.

The strong relationship between the three variables does, nonetheless, call for some caution. It implies that the size premium/discount should only be applied when risk has been adjusted for using the original CAPM model developed by Sharpe (1964), Lintner (1965) and Black (1972). If M/B or D/P have somehow been incorporated into the model[38], a premium/discount should not be added since either of the two above mentioned variables will already, to some extent, have corrected for the size effect.

5.2 The magnitude of the size effect

The mathematical relationship between size and risk adjusted return is represented by [5]. By introducing the log of MC, a SP value for the company in question will be provided. The relationship between SP and the log of MC provided by this formula is linear. This method of estimating an SP is supported by Brown, Kleidon and Marsh (1983) who argue that the relation between risk adjusted returns and firm size can be regarded as linear in the log of MC.

Using this formula, table 6 displays the SP in the same format as the PwC (2009) report (table 1). The results of this empirical study based on historical returns and the questionnaire by PwC differ substantially, although both do show a negative relationship between MC and risk adjusted return (see table 10).

[38] As in the three-factor model developed by Fama and French (1993)

Table 10: Discrepancy in size premiums

Average firm size within portfolios (MC)	Size premium	
	Bonnier & Rodriguez (2009)	PwC (2009)
MSEK 5000	0,7%	1,2%
MSEK 2000	2,0%	1,6%
MSEK 500	4,0%	2,6%
MSEK 100	6,3%	3,9%

The main difference between the two is the greater pronouncement of the size effect seen in the results from this study. For example, the size premium suggested from this paper with regards to the smallest companies is 6.3% compared to 3.9% for the PwC (2009) study. There are several possible explanations for this deviation. Studies with a similar purpose as this paper, conducted by the different actors which provide the results of the PwC study, may have been conducted differently. One difference could be that the estimated betas in our study suffer from a non-adjusted infrequent trade syndrome, as discussed in section 5.3.5 Infrequent trade, while betas estimated by practitioners, does not. This is, however, unlikely since standard practice for intervals between observations when estimating beta is rarely longer than one week. Hence, these estimations also suffer from infrequent trade, which suggests that this factor does not explain the discrepancy.

Another explanation might lie in the sample selection process. For this study, all companies listed on the Stockholm Stock Exchange were included. Other studies may have omitted lists not covered by OMX such as e.g. Aktietorget, which are largely made up of micro cap companies. If small firms have higher risk adjusted returns than large, this should produce a larger average risk adjusted return for the portfolios containing the smallest companies in our study. As a consequence, the line of best fit in our study should, everything else being equal, have a steeper slope than a study which does not cover these lists, resulting in higher SPs.

Apart from the companies used in the sample, the time period analyzed might differ. Although the robustness test presented in 4.6 shows that the relationship between size and risk adjusted return is not significant for the period 1998 to 2007, it does show that the coefficient for MC is less steep for this period than for the period 1988 to 2007. A study covering only the period between 1998 and 2007 should therefore, on average, produce lower risk adjusted returns. Hence, if actors within Corporate Finance study a shorter period than the 20 years covered in this paper, they should arrive at lower SPs. In addition, the lack of significance for the studied relationship during the latter ten year period may have made practitioners more careful in the application of a SP and therefore biased it downwards.

Another explanation to this deviation between the application of the SP in practice and what is suggested by studying the empirical evidence could be that practitioners with no possibility to perform a study themselves, have had no other option but to look at studies made on US data for guidance, since a comprehensive study on this phenomenon does not exist for the Swedish stock market. Each year, Ibbotson Associates publish the "Risk Premia Over Time Report" which provides a SP based on long-term historical return data. The results from the last publication can be found in table 11. The largest premium added is 4.0%. Although the firms to which this premium is added have a MC of MSEK 1 800 to 2 900, such information might make practitioners hesitate to apply a SP larger than 4%, regardless of size.

Table 11: Risk Premia Over Time Report (Ex. Rate: 8.35 SEK/USD)

Size (MC) in MUSD	Size (MC) in BSEK	SP
725 to 1129	6,1 to 9,4	2,2%
364 to 724	3,0 to 6,0	2,6%
212 to 363	1,8 to 2,9	4,0%

5.3 Theoretical explanations for the size effect

Hitherto, this paper has primarily focused on the existence of the size effect. The next section will present theories put forward in literature as suggested explanations of the empirical relationship between firm size and stock returns documented in this study.

5.3.1 Risk of business failure

A common perception within finance, among both practitioners and researchers, is that small firms are associated with a higher probability of business failure[39]. There are many factors behind this reasoning, one being that small firms often operate within fewer sectors than larger conglomerates and are thereby operationally less diversified, which makes them more sensitive to a changing economic environment. In addition, small firms cannot usually benefit from large economies of scale in comparison to their bigger competitors. As argued by Chan and Chen (1991), “marginal firms” with inefficient production, varying levels of cash flows and relatively higher levels of financial leverage are less likely to survive adverse economic conditions. Not surprisingly, the marginal firm characteristics are shown to be more common for small firms than for big. As stated earlier, Kim and Burnie (2002) discovered that small firm stocks perform relatively worse during economic downturns in comparisons to large firms, implying that the stock markets consider small firms to be riskier during insecure economic times; a riskiness which arguably is connected to the higher chances of business failure.

Small firms’ higher probability of failure has also been documented in financial research. When constructing a model to identify bankruptcy risk, Altman, Haldeman and Narayanan’s (1977) result indicates that smaller companies, here defined as the book value of the firm’s tangible assets, appear to have a higher probability of bankruptcy than large firms. The findings presented in Assadian and Ford’s (1997) study, in which the probability of business failure is assumed to be a function of negative profits, support the result of Altman, Haldeman and Narayanan (1977). By observing the effects of earnings, inflation rates and the overall economic climate, Assadian and Ford (1997) conclude that most businesses which fail seem to do so in the first three years of their life, i.e. usually when the operational size of the firm is very small.

The perception of smaller firms having a higher probability to fail appears to be empirically supported, at least on the US stock market. But what implications does a higher risk of business failure have with regards to explaining the documented size premium on the Stockholm Stock Exchange, presented in this study? The logic behind a high risk of business failure being an explanation for the risk adjusted returns experienced on small firm stocks is that if an investor trades off risk and return, he/she would demand a higher risk premium than the one captured by

[39] Defined as bankruptcy and/or composition agreement, voluntary closure of the main operating activity or substantial government support, Skogsvik (1988)

the CAPM model, as the CAPM model does not incorporate the risk of business failure. Hence the required rate of return of a small firm stock, which is commonly included in the discount rate in corporate valuation, would need to be revised in order to adjust for the higher probability of failure associated with small firms. Skogsvik (2006) presents this adjusted discount rate in [6]:

[6] $$Re_i' = \frac{Re_i + P_{fail,t}}{1 - P_{fail,t}}$$

Where

Re_i' *= Expected return for company i, adjusted for probability of failure*

Re_i *= Expected return for company i*

$P_{fail,t}$ *= Probability of failure for company i in period t, given survival in period t-1*

From [6] it is obvious that a high $P_{fail,t}$ results in a higher expected return, which in turn would result in a lower risk adjusted return, everything else being equal. Hence, the incorporation of $P_{fail,t}$ into the calculation of the expected return could shed some light on why small firm stocks appear to have higher risk adjusted returns than large firm stocks. Even though examining whether the risk of business failure possesses explanatory power for risk adjusted returns or not is beyond the scope of this thesis, such studies have been performed on Swedish data. When examining the explanatory power that probability of failure has on risk adjusted returns on the Stockholm Stock Exchange, Ohlsson, Toll and Wessberg (2008) provide evidence that the risk of failure to some extent is captured by the size effect, using a prediction model presented in Skogsvik (1988). Although no general conclusion should be drawn based solely on the results reported in their study, the findings of Ohlsson, Toll and Wessberg (2008) is in line with the perception that the Swedish small firm effect could be explained by the higher risk of business failure associated with small firm stocks.

5.3.2 Neglected firm effect

As mentioned in section 3.1.5 Neglected firm effect, Arbel and Strebel (1982) show that small firms are neglected to a greater extent than large firms, when neglect is defined as lacking analyst coverage. Arbel, Carvell and Strebel (1983) continue this research and argue that small firms are neglected by analysts to a greater extent than large firms since they are unsuited as investment objects for financial institutions. The reasons for this neglect by the financial institutions of small firm stocks are said to be threefold. First of all, the typical size of an institutional investment might affect prices and liquidity of the small stock which is often thinly traded. Second, the large investments pursued by the institutions would frequently result in ownership fractions exceeding those limits that imply insider's reporting duty to comply with SEC regulations[40]. Finally, this high ownership fraction might also become large enough to necessitate input of managerial resources, which is seldom included in these investors' specific knowledge. Arbel, Carvell and Strebel (1983) describe institutional investors as giraffes that only focus on the tall trees in the investment forest and ignore the underbrush, which could explain the relationship between neglect and firm size.

[40] In Sweden, shareholders owning 10% of the equity capital or control more than 10% of the voting rights have reporting duty to the Swedish Financial Supervisory Authority

Another theoretical explanation for why neglected firm stocks (often small firm stocks) provide higher returns is presented by Carvell and Strebel (1987). They argue that the investors are compensated for the information uncertainty associated with small firm stocks, i.e. the relative lack of information about the investment's future return distribution. The lower degree of insight into small firms' financial and operational situation creates additional investment risk for the shareholder. Assuming once again that an investor trades off risk and return, he/she should therefore be compensated for the additional risk-taking associated with investing in small firm stocks. Hence, the required rate of return of the investor would increase when small firm stocks constitute the investment object.

For the purpose of explaining the size premium, it is interesting to note that these studies find that neglected firms provide, on average, higher risk-adjusted returns than other stocks; a discovery which in the theoretical research has been labeled the "neglected firm effect". This implies that smaller firms over time should earn higher risk adjusted returns than large, and could therefore provide explanatory value to the discovered size premium in our study.

When considering small *private firms* in a valuation context, the neglected firm effect is in theory even more applicable. Since the typical private firm is neither covered by analysts nor held by institutions, one could label it as extremely neglected. In addition, if the private firm is of a small operational size, the publicly available information of the firm ought to be diminutive. The investor of such a firm should, in theory, be compensated for the risk implied by the extreme level of information uncertainty. Urwitz (2009-03-05) also confirms that this risk premium is applied in practice, when valuing small private firms. Provided that there is a correlation between operational size and market value, the findings of the neglected firm effect in the theoretical research has an impact on the valuation of small private firms, even though previously mentioned studies have only been performed on publicly listed stocks. This explanation is consistent with the development over time of the size effect. As the size premiums for small companies were unveiled, institutions gained interest in them and the neglect decreased and thereby also risk adjusted return.

For the purpose of explaining the outcome of the tests conducted in this study, we do not however believe that the neglected firm effect possesses any significant explanatory power. Considering the relative ease of obtaining company specific information for companies of all sizes listed on the Stockholm Stock Exchange, a risk premium arising from information uncertainty is unlikely to explain the difference in cross-sectional returns between small -and large firm stocks. It should, however, be noted that since our observations date back to the 1980's when information was not as readily available as in later decades, our early observations may have been affected by the neglected firm effect.

5.3.3 Non-diversified investors

One of the cornerstone assumptions in the CAPM framework is that the investor is fully diversified and therefore only rewarded for non-diversifiable risk. This is, in most cases, not entirely true. Especially for owners of small firms who can often be expected to have a large part of their portfolio tied up in their own company, Damodaran (year unknown). This is also the case for smaller private equity firms with a limited number of portfolio companies. In fact, most non-institutional investors cannot be expected to be able to diversify their portfolios completely. Hence, owners of small firms will require compensation for the inability to diversify *as well as* for the market risk represented by the CAPM beta[41]. This implies a return in excess of CAPM for shares where a significant part of owners are non-diversified, as is often the case for small firms.

After the publication of Banz (1981), evidence has been presented showing a change in the direction of the size effect. Instead of a size premium for small firms, a size discount was observed. As has been argued before, this might be a consequence of investors wanting to exploit a presumed inefficiency on the market. If institutional investors acted upon this information and increased their participation in smaller firms, their higher level of diversification, and therefore lower required return, may have contributed to the relative decrease in return for these shares.

Damodaran (year unknown) takes this one step further by presenting a model to adjust betas upwards in order to compensate for investors' inability to diversify. In a valuation context, this means that the value of the firm in question will vary depending on the level of diversification of the potential buyer. However, when a company is available for sale, there are usually many competing potential buyers with different possibilities to diversify. This implies that if one potential investor is unable to diversify further, there is usually another who can. When valuing a company, it is therefore not rational to adjust the discount rate in order to reflect one or more potential buyers' inability to diversify. The level of diversification must, however, be taken into consideration in the valuation performed by the potential buyer.

Although inability to diversify might explain a fraction of the risk adjusted returns for small firms observed in this study, it is unlikely to explain the phenomenon in its entirety due to the characteristics of the Swedish stock market[42]. Even if it would, the arguments presented by Damodaran suggest that it should not be applied when performing a valuation from the seller's perspective.

5.3.4 Illiquidity and transaction costs

"When you buy a stock, bond, or a business, you sometimes face buyer's remorse, where you want to reverse your decision and sell what you have just bought. The cost of illiquidity is the cost of this remorse", Damodaran (2005). One way of capturing this cost is through transaction costs, with less liquid assets bearing higher costs and vice versa. According to Damodaran (2005), there are, in addition to the *brokerage commission*, three different costs related to a transaction. First, there is the difference between the price at which you can buy the asset (dealer's ask price) and the price for which the asset can be sold at the same point in time (dealer's bid price). In most markets there is a dealer who sets this *bid-ask spread* in order to cover for costs such as holding inventory and processing orders. Second, there is the *price impact* that an investor can create by pushing up the price when buying large quantities of an asset. Third, there is the *opportunity cost associated with waiting*; if for example, the investor wants to decrease the price impact by purchasing the asset in smaller pieces over a long period, he/she runs the risk of having to pay a higher price for the asset, or not being able to acquire it at all.

It could therefore be argued that a substantial part of the transaction costs associated with trading shares is related to the liquidity of the asset. With this perspective, transaction costs are merely a proxy for illiquidity with less liquid assets being associated with high costs and vice versa.

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[41] It is not uncommon for Segulah AB to apply a Re of 25-30 percent when valuing a potential acquisition candidate. Part of the explanation for this above average required return is the concentration of resources into a single company, i.e. the lack of diversification, Urwitz (2009-03-05)

[42] Swedish institutional investors can be expected to be relatively more willing to invest in small firm stocks in comparison to their counterparts in other countries due to the limited size and transparency of the market

Due to the costs associated with owning an illiquid asset, an investor will pay less to purchase such an asset. One way of capturing the impact of illiquidity on value, is to incorporate it into the discount rate of the CAPM model. Such an attempt was made by Acharya and Pedersen (2005) who created an illiquidity beta reflecting the covariance between the asset's illiquidity and that of the market. Pastor and Stambaugh (2002) also conclude that what matters is not the stocks liquidity per se but rather the relationship to the overall market liquidity. Their study shows that stocks whose returns are more sensitive to market liquidity have experienced yearly returns that are 7.5% higher than stocks whose return do not follow this pattern. Another study providing evidence that investors require higher returns for holding illiquid assets was made by Amihud and Mendelson (1986). They study NYSE stocks from 1961-1980 and find that every 1% increase in the bid-ask spread (as a percentage of stock price) increased annual expected return by 0.24-0.26%.

This empirical evidence suggests that discount rates should be augmented with an illiquidity premium in order to compensate investors for holding illiquid assets. Damodaran (2005) argues that this premium is determined by the adversity to illiquidity among investors on the market, which in turn depends on the length of the investment horizons of said investors. Since investors with long investment horizons do not demand liquidity, markets where these investors are abundant will sport small liquidity premiums and vice versa.

Stoll and Whaley (1983) show that the transaction costs for trading stocks are inversely proportional to firm size. Following the reasoning of transaction costs being a proxy for illiquidity, their findings suggest that small firms are more illiquid than large. Damodaran (2005) strengthens this view by arguing that illiquidity is more pronounced for small firms than large and does not rule out that the size effect, which has remained a mystery since it was first discovered by Banz (1981), might in part consist of an illiquidity premium. However, a number of studies[43] have been able to show a strong relationship between illiquidity proxies and stock returns, even after adjusting for sources of market risk, such as size.

Although a part of the size effect can be explained by illiquidity, the empirical research is not coherent enough to claim that illiquidity is the answer to the size mystery. With regards to this study, the level to which illiquidity accounts for the identified size effect should depend on the investment horizon of the investors on the Swedish stock market. It could be argued that, historically, owners of small firm stocks had a relatively long investment horizon since these owners were usually also the founders of the firm. In time, as the flow of information improved and thereby the transparency on the stock market, the ownership of small firm stocks should gradually have even out to also include other investors, with shorter investment horizons. The size premiums we have registered might therefore partly be a consequence of an increased cost of illiquidity. However, although the price of illiquidity increases with shorter investment horizons, illiquidity in itself decreases due to the increased activity on the stock market, which should result in a lower risk of illiquidity for shareholders[44]. Despite this argument, it is still probable that the shares of small companies are associated with a higher cost of illiquidity than large company shares and therefore that illiquidity is a possible explanation to the size effect observed in this study.

[43] See Brennan, Chordia and Subrahmanyan (1998), Datar, Nair and Radcliffe (1998), Nguyen, Mishra and Praksh (2005)

[44] It is assumed that shorter investment horizons increases trade and thereby the liquidity on the market

5.3.5 Infrequent trade

Dimson (1979) documents a negative correlation between market capitalization and trading frequency in the UK stock market, i.e. that small firm stocks trade less frequently than large. The same conclusion is drawn for the US market in a study by Forester and Keim (1993) in which a clear relationship between a stock's market capitalization and the likelihood of it being traded is proven to exist between 1926 and 1990. A few years later, Clare, Morgan and Thomas (2002) also confirm a relationship between firm size and infrequent trading. But what do these empirical findings imply for the explanation of the size premium discovered in this study?

Roll (1981) argues that "trading infrequency seems to be a powerful source of bias in risk assessments with short interval data". In other words, the reason to why small firms have experienced higher risk adjusted returns than large firms is not necessarily caused only by the failure of CAPM to represent the inherent risk of a particular security, but rather due to a failure of correctly estimating beta for small firm shares that trade infrequently. Infrequent trade complicates the assessment of a correct correlation of a share and a defined market index since the share quote of an infrequently traded security does not necessarily reflect the value of the share. This causes a mismatch when comparing the return of the share in question, with the index. Since the return of a share which has not traded within the period in question is zero, and the return on the index is more likely than not different from zero, the correlation, and hence the beta of the share in question, will be understated. An underestimated beta will underestimate the expected return and thereby overestimate risk adjusted return. Due to the documented fact that the shares of low MC companies tend to trade less frequently than the shares of large companies, overestimation of risk adjusted return will be biased towards small firm stocks. Based on this reasoning, the size premium reported in this study could possibly in part be explained by the higher degree of infrequent trading of small firm stocks.

As stated in section 2.2.2 CAPM and beta estimation, we have taken the argument of infrequent trading into consideration when estimating the beta factors, as we extended the trading interval to weekly observations instead of daily observations. In this study however, small firm stocks still appear to generate higher risk adjusted returns than large, even after this adjustment. Therefore, this adjustment was either not sufficient enough to correct for infrequent trade, or, there are more factors than infrequent trade involved in the size effect. Roll (1981) concludes that the bias in risk estimates due to non-frequent trading cannot explain the magnitude of the risk adjusted average returns, as the size effect still remains after adjusting for the beta assessment bias. However, in the case of our study, the infrequent trading argument could still possess explanatory power over the documented size premium since adjustments for infrequent trade have not been pursued in other ways than by an increase of the trading interval.

Historically, small firm stocks have been associated with a higher beta than large firm stocks[45]. Considering the cross-sectional beta development for small –and large firms (see appendix 3), we suspect that the adjustments made in this study have not been sufficient enough to counter the downward bias in our beta estimations, caused by infrequent trade. Therefore, the infrequent trade argument is a strong candidate for explaining the size effect present in our sample.

Irrespective of whether or not the infrequent trade phenomenon can explain the size effect, it is not necessarily an argument for applying a size premium on the Re when valuing a stock since it

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[45] See Brealey, Myers and Allen (2005) for further discussions on this topic

depends on the beta estimation method used in each particular case. A size premium should only be applied if beta is calculated in such a way that infrequent trading is not corrected for.

5.3.6 The January effect

As mentioned in section 3.1.3 The January effect, previous researchers have documented a seasonal behavior of the relationship between risk adjusted return and size. Keim (1983), one of the pioneers behind this detection, referred to it as the "January effect", based on his discovery that the relation between risk adjusted risk adjusted returns and size is more pronounced and *always* negative in January, compared to any other month. Over the research period 1963-1979, Keim (1983) claims that approximately 50% percent of the average magnitude of the size effect is attributable to January risk adjusted returns. The reason for this effect is by Reinganum (1983) and Roll (1983) said to be caused by investors' incentives to realize capital losses at year end for tax purposes. Those stocks that have performed badly during the year (prior year "losers") will be sold in order to realize tax-deductible capital losses, which results in even further downward pressure of the prices of these stocks. In the beginning of the subsequent year, prices revert to fair values which create a January return boom[46]. According to Keim (1983), this effect is significant already during the first few trading days of January. However, as expressed by Reinganum (1983), "tax-loss selling cannot explain the *entire* January seasonal effect since the small firms least likely to be sold for tax reasons (prior year "winners") also exhibit large average January returns."

The reasons for why this effect is in general more pronounced for small firm stocks are twofold. Firstly, smaller stocks are typically associated with a higher volatility in price changes, which implies a larger probability of a price decline over the year. Secondly, as Roll (1983) argues, companies whose stock prices have fallen during the year are, by the definition of market capitalization, smaller at year end than in the beginning of the year. Hence, those companies whose market capitalizations were large (or at least larger) in the beginning of the year could by year end be small. Therefore, it is not surprising that the January effect is more pronounced for small-firm stocks.

Whether or not the January effect, resulting from tax-loss selling at year end, could serve as an explanation for the documented size premium reported in this study is not possible to tell as our data is not constructed using monthly returns, but yearly. Nevertheless, since tax-loss selling is legally applicable for Swedish companies during most of our research period, the January effect could at least theoretically explain a part of our documented size premium.

In 2005, however, many Swedish companies were enforced to adopt new accounting standards, the International Financial Reporting Standards (IFRS), set by the International Accounting Standards Board (IASB). For many Swedish companies, including institutional investors, this change implied that short-term financial assets, such as financial securities, will henceforth be reported at fair values[47]. When not only realized but also unrealized tax losses became tax deductable, the incentive to sell bad performing stocks at year end ought to have been reduced. Hence, even if our sample included a January effect, it should not have been as pronounced after the adoption of IFRS in 2005.

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[46] A numerical example can be used to further explain this effect. Assume a stock whose price has fallen to SEK 100 in December year 0. Due to extensive tax-loss selling, the stock price decline even further, with say 10% to SEK 90. In January, the stock price conversely reverts to its fair value, at least equaling SEK 100. This increase equals 11.1% and is hence larger than the decrease in December.

[47] See White, Sondhi and Fried (2003)

5.4 Summary and implications

CAPM only compensates for beta risk, i.e. fluctuations of share value relative to the market index. It does not, however, cover the risk of business failure which could be expected to be particularly high for small companies. We therefore suspect that the risk of business failure could explain a significant part of the size effect on the Swedish stock market. This view is supported by Ohlsson, Toll and Wessberg (2008). Another good candidate for explaining the cross sectional difference in risk adjusted return in our sample is infrequent trade. Note that this is only an argument for adding a SP if beta has been estimated using a method similar to that used in this paper. Illiquidity could also play a significant part in explaining the size effect.

We suspect that in addition to possessing different explanatory power between themselves, the explanatory power of each different phenomenon may have varied over time. Although the January effect may have had some explanatory power before the introduction of IFRS, its impact should be on the decline ever since. The neglected firm effect may also be expected to have lost importance as information asymmetry decreased over time.

6 Conclusions

This paper, which studies returns on the Swedish stock market during the 20 year period from 1987 to 2007, provides evidence for the existence of a size effect. For firms with a market capitalization of MSEK 100, an average size premium (SP) of 6.3% has been calculated for the period. This supports an augmentation of the required return for small companies, which today is common practice among valuation practitioners in Sweden.

In order to determine the size premium for a firm of a given MC, [5] can be used. Alternatively, table 6 can provide a benchmark. As shown in table 10, there is a significant discrepancy between the SP that practitioners apply and the SP reached in this empirical study. This could be a consequence of practitioners employing a different research method than that which has been used in this study.

We find the main theoretical arguments for applying a size premium when performing a valuation using CAPM to be incorporating the risk of business failure and illiquidity. Both risk factors have been found to be of substantial importance to investors, but are not accounted for in the CAPM framework. Although it would have been of great interest, it was decided to leave empirical testing of the different possible explanations for the size effect outside the scope of this study. This would, however, be an excellent topic for further research.

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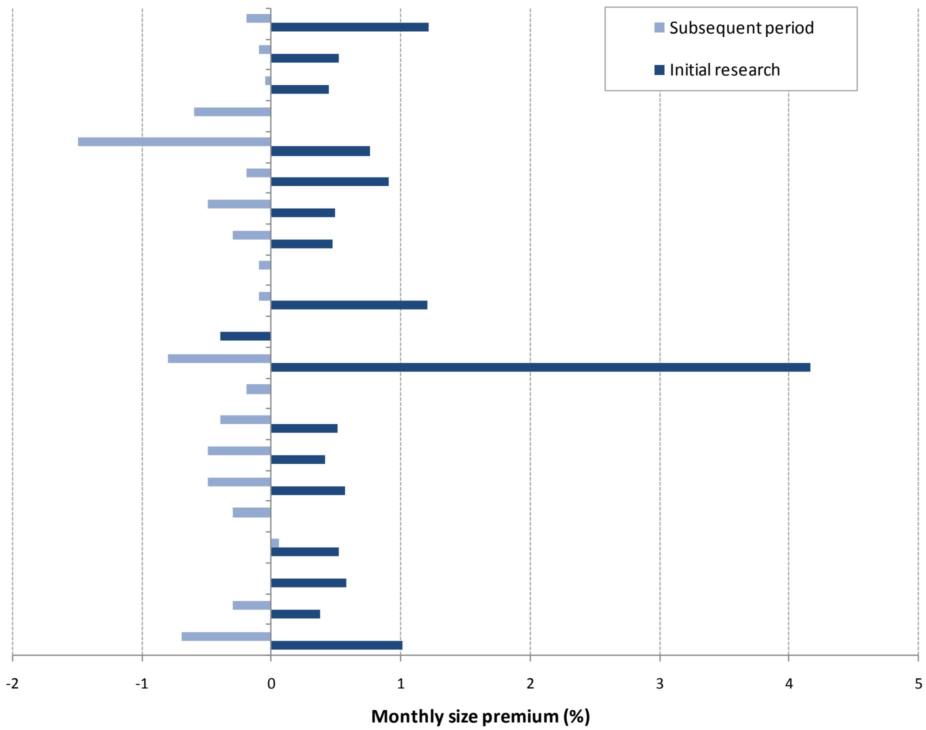
8 Appendix

8.1 Appendix 1: The size effect world-wide



	Initial publication year of size effect	Test period for initial research	Monthly size premium initial research (%)	Monthly size premium subsequent period (%)
Australia	1983	1958-81	1,21	-0,20
Belgium	1989	1969-83	0,52	-0,10
Canada	1984	1973-80	0,44	-0,05
Denmark[1]	N.A	N.A	N.A	-0,60
Finland	1986	1970-81	0,76	-1,50
France	1993	1977-88	0,90	-0,20
Germany	1992	1954-90	0,49	-0,50
Ireland	1988	1977-86	0,47	-0,30
Italy[1]	N.A	N.A	N.A	-0,10
Japan	1991	1965-87	1,20	-0,10
Korea[2]	1992	1984-88	-0,40	N.A
Mexico	1994	1982-87	4,16	-0,80
Netherlands[1]	N.A	N.A	N.A	-0,20
New Zealand[3]	1990	1977-84	0,51	-0,40
Singapore	1990	1975-85	0,41	-0,50
Spain[3]	1988	1963-82	0,56	-0,50
Sweden[1]	N.A	N.A	N.A	-0,30
Switzerland	1991	1973-88	0,52	0,05
Taiwan[2]	1990	1979-86	0,57	N.A
U.K	1987	1955-86	0,37	-0,30
U.S	1981	1931-75	1,01	-0,70

[1] Initial research studies of the small firm premium are not available for these countries. Therefore, initial research-bars are omitted and the subsequent period-bars cover the period 1990-2000.

[2] Subsequent period-bars are omitted for these countries since size-based indices for these countries are not available.

[3] Returns for these countries are risk-adjusted

8.2 Appendix 2: Summary table of size effect researchers

Author	Publication year	Sample	Period	Focus	Comment
Banz	1981	NYSE	1931-1975	Size effect	Discovers a significant relationship between a firm's market cap and risk adjusted return
Reinganum	1981	NYSE and AMEX	1963-1979	Size effect and E/P ratio	The size effect is still significant when controlling for E/P
Roll	1981	NYSE, AMEX and S&P 500	1962-1977	Trading infrequency	Trading infrequency seems to be a powerful source of bias in risk assessments with short interval data
Arbel and Strebel	1982	S&P 500	1970-1979	Neglected firm effect	Small firms are neglected to a greater extent than large firms, and neglected firms are proven to have higher risk
Keim	1983	NYSE and AMEX	1963-1979	January effect	50% of size effect can be explained by abnormal January returns
Reinganum	1983	NYSE and AMEX	1963-1979	January effect	Tax-loss selling at year end can partly explain abnormal January returns
Roll	1983	N.A.	N.A.	January effect	Tax-loss selling at year end can partly explain abnormal January returns
Arbel, Carvell and Strebel	1983	NYSE and AMEX	1971-1980	Neglected firm effect	Small firms are neglected to a greater extent than large firms, and neglected firms are proven to have higher risk
Stoll and Whaley	1983	NYSE	1955-1979	Transaction costs	The explicit cost associated with trading a stock is inversely proportional to firm size
Schultz	1983	NYSE and AMEX	1962-1978	Transaction costs	Transaction costs do not completely explain the sife effect
Elton, Gruber and Rentzler	1983	NYSE	1927-1976	Dividend yields	Small firm stocks are linked to zero-dividend stocks, which in turn are proven to be related to excess return
Amihud and Mendelson	1986	NYSE	1961-1980	Transaction costs and illiquidity	An illiquidity premium, due to relatively higher transaction costs, could explain the size effect
Carvell and Strebel	1987	NYSE	1976-1982	Neglected firm effect	The neglected firm effect is independent of, and may dominate, the size effect
Chan and Chen	1991	NYSE	1956-1985	Structural characteristics	The size proxy does not possess explanatory power after controlling for structural characteristics of firms
Fama and French	1992	NYSE, AMEX and Nasdaq	1941-1990	Size and Book-to-market	Size and B/M have higher explanatory power of the cross-section of returns than beta
Black	1993	NYSE	1926-1991	Beta	Argues that Fama and French (1992) are pursuing data mining, and that beta has explanatory value in forecasting
Elfakhani and Zaher	1998	NYSE and AMEX	1986-1990	Neglected firm effect	The neglected firm effect might explain the size effect
Dimson and Marsh	1999	HGSC[1] and NYSE	1955-1997	Size effect over time	Discovers a size premium until 1983 (in U.S) and 1988 (in U.K), then reversal in both countries
Horowitz, Loughran and Savin	2000	NYSE, AMEX and Nasdaq	1963-1997	Size effect over time	Discovers a size premium until 1981, then reversal
Hawawini and Keim	2000	17 countries	1951-1994[2]	Size effect world-wide	Discovers a size premium in 16 of 17 countries
Dimson, Marsh and Staunton	2002	19 countries	1981-2001[3]	Size effect world-wide	Discovers a size discount in 17 of 18 countries
Kim and Burnie	2002	S&P 500	1976-1995	Economic cycles	The size effect appears to be more present in the expansion phase of an economic cycle
Schwert	2003	NYSE, AMEX and Nasdaq	1982-1997	Size effect	Discovers a size discount after 1981
Ibbotson Associates	2003	NYSE, AMEX and Nasdaq	1926-2002	Size effect over time	Discovers a size premium over the whole period, but raw size discount since 1981
Al-Rjoub, Varela and Hassan	2005	NYSE, AMEX and Nasdaq	1970-1999	Size effect	The discovered size effect reversal could be due to increased trading of small firms
Marquering, Nisser and Valla	2006	Dow Jones	1960-2003	Yes/No	Discovers a size premium until 1981, then reversal, then reappearance between 1999-2003
Dimson, Marsh and Staunton	2006	16 countries	2000-2005	Size effect world-wide	Discovers a size premium in 15 of 16 countries in the beginning of the 2000s'

[1] Hoare Govett Smaller Companies index
[2] The periods vary between countries, within this range
[3] The periods vary between countries, within this range

8.3 Appendix 3: Portfolio data summary

Portfolio rank by size	Average MC[1] 1988-2007	Average MC[1] 1988	Average MC[1] 2007	Average MC 2007/Average MC 1988	Log of average MC 1988-2007	Raw return 1988-2007	Spread in raw return 1988-2007	Beta 1988-2007	Risk adjusted return 1988-2007	Spread in risk adjusted return 1988-2007	Average dividend yield 1988-2007	Average market-to-book 1988-2007
1	10,3	14,1	10,4	0,7	1,0	31,1%	242,4%	0,4	17,6%	227,1%	0,8	0,9
2	26,7	35,9	24,1	0,7	1,4	15,6%	183,1%	0,4	2,5%	170,2%	1,3	2,1
3	40,3	51,6	35,0	0,7	1,6	24,9%	238,9%	0,3	12,5%	222,3%	1,6	1,5
4	57,7	62,6	46,4	0,7	1,8	18,6%	244,9%	0,4	6,0%	241,9%	1,2	2,5
5	77,4	87,1	65,5	0,8	1,9	18,5%	205,6%	0,4	5,0%	185,2%	1,8	1,4
6	99,1	110,7	93,0	0,8	2,0	22,9%	230,6%	0,5	9,0%	197,3%	1,4	1,9
7	126,6	128,4	134,0	1,0	2,1	14,3%	149,5%	0,5	0,7%	129,8%	1,3	2,0
8	156,6	145,2	164,4	1,1	2,2	21,1%	287,1%	0,5	9,3%	261,1%	1,8	2,1
9	192,5	169,2	201,3	1,2	2,3	21,9%	148,6%	0,6	5,8%	106,0%	1,8	2,0
10	236,5	208,0	247,3	1,2	2,4	34,3%	365,2%	0,6	13,3%	255,8%	1,9	2,0
11	288,6	260,2	334,8	1,3	2,5	16,3%	212,4%	0,5	1,5%	181,0%	1,9	2,1
12	361,2	307,0	445,4	1,5	2,6	11,7%	134,2%	0,6	-3,0%	104,9%	2,4	2,6
13	448,6	403,4	562,6	1,4	2,7	15,7%	135,3%	0,5	2,4%	119,5%	2,0	2,6
14	561,0	489,0	735,4	1,5	2,7	22,0%	202,1%	0,6	6,8%	166,8%	2,0	2,8
15	699,7	599,5	897,3	1,5	2,8	19,6%	145,7%	0,6	4,6%	129,1%	2,2	2,5
16	881,8	764,4	1 155,4	1,5	2,9	13,8%	143,5%	0,6	-0,4%	114,3%	2,6	3,1
17	1123,5	1 058,7	1 436,8	1,4	3,1	10,3%	122,2%	0,7	-4,3%	109,5%	2,6	2,7
18	1472,5	1 338,4	1 965,1	1,5	3,2	16,7%	143,1%	0,6	0,6%	109,2%	2,7	2,7
19	2011,0	1 733,9	2 825,8	1,6	3,3	17,2%	152,9%	0,7	1,3%	113,9%	2,8	3,1
20	2742,7	2 092,1	3 934,5	1,9	3,4	12,6%	75,7%	0,7	-4,3%	49,7%	2,3	3,4
21	4006,6	2 598,3	5 931,2	2,3	3,6	16,3%	104,2%	0,6	1,6%	71,7%	2,7	4,6
22	6029,2	3 480,7	10 067,2	2,9	3,8	21,8%	186,9%	0,7	3,9%	119,3%	3,1	4,9
23	10014,9	5 240,6	17 439,0	3,3	4,0	19,6%	90,8%	0,7	2,3%	57,2%	2,8	2,4
24	21783,2	7 905,5	36 411,1	4,6	4,3	23,2%	106,9%	0,8	4,4%	41,9%	2,6	3,6
25	78469,0	14 436,2	167 157,0	11,6	4,9	17,6%	89,0%	0,9	-2,4%	48,3%	2,6	3,5

[1] Presented in MSEK