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Profit Expectations of Startups in the Nordics

A profit expectation study of publicly-listed startups in the Nordic market using the Residual Income Valuation (RIV) model

Junehee Han* **Ian Clark†**

ABSTRACT

This paper investigates the reasonableness of the expected returns on equity for startups in the Nordics. With a sample of 109 companies listed in Sweden, Norway, Finland, and Denmark, we deduce the market's expected profitability represented by the implied return on equity from a Residual Income Valuation (RIV) model through reverse engineering. The reasonableness of these profit expectations is evaluated through a statistical comparison to how similar companies in a comparable industry groups have performed historically in terms of return on equity. The average historical industry ROEs are hence used as a definition of reasonable expectations of future ROE. From the analysis, we conclude that the stock prices, which are represented by return on equity expectations, are beyond the levels that the historical averages would indicate as reasonable.

Keywords: Fundamental valuation; implied return on equity; profit expectations; residual income valuation.
Supervisor: Stina Skogsvik, Assistant Professor, Department of Accounting at the Stockholm School of Economics
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* 41563@student.hhs.se
† 41361@student.hhs.se

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1. Introduction

A wealth of prior literature has supported the notion that entrepreneurship is positively correlated with a country's innovation, competitiveness, growth in gross domestic product, and overall wealth and prosperity (Acs & Varga, 2005; Acs et al., 2016; Berkowitz & DeJong, 2005; Thurik, 1995; Van Praag, 2007). Recognizing this, the European Union has adopted the promotion of entrepreneurship as part of its cohesion policy, and specifically targeted startups for support in January 2014 when the Startup Europe Partnership was founded. Building further upon this, the Nordic governments each have their own national strategies for entrepreneurship, with countries such as Sweden and Denmark even having their own government-sponsored venture capital fund (e.g. *Industrifonden, Vinnova and Vækstfonden*). While the Nordics account for only 2% of global GDP, they are also responsible for over 10% of venture capital exits from so-called "unicorn" firms (Creandum, 2015). Clearly, the startup scene is of keen interest to both investors and governments in the Nordics, and therefore it is necessary to understand the accuracy of startup valuation and pricing to ensure efficient investment decisions and public policy.

The Nordics present an interesting region to study due to their excellence in promoting the formation of new businesses, on a level that is remarkable for a region of roughly 25 million inhabitants. The four mainland Nordic nations of Sweden, Norway, Finland, and Denmark share many historical, cultural, social, and economic traits, including high levels of innovation, a high standard of living, low economic inequality, a large public sector and welfare state, strong focus on social equality, high educational attainment and performance, and all have produced a disproportionate number of the world's most successful and impactful startups (Ahl et al, 2016; Kuckertz et al., 2015; Warhuus & Basaiawmoit, 2014). Karlsson et al. (1993) find that innovation and entrepreneurship are positively correlated with higher tertiary educational attainment and higher government investment in research and development, upon which the Nordic countries rank highly. Dvoulety (2016) studied the determinants of Nordic entrepreneurship and confirms that unemployment and GDP per capita correlate positively with entrepreneurial activity, while administrative barriers hold back entrepreneurship and business formation.

Accurate valuation and pricing of startups is a problem that has been heavily discussed and debated within both academic and valuation practice. Commonly used valuation models, such as the discounted cash flow and dividend discount models, which are based upon accounting numbers, have been questioned in their ability to properly value firms with little to no financial history and those that do not pay out dividends (Damodaran, 2009), and empirical investigations have found that the models consistently generate overly optimistic valuations which leads to mispricing of stocks (Mumtaz & Smith, 2015; Colgiati et al, 2010). Additionally, there is a wealth of research about market mispricing; however, the focus has primarily been on the United States and comparatively little research on market mispricing in the Nordics exists (Skogsvik, 2008); furthermore, no studies specifically studying mispricing of startups exists to our knowledge. This has serious implications for casual investors who may lack the time, knowledge, and skills to conduct a fundamental valuation with reasonable assumptions. Often, these investors are far too optimistic when it comes to their eventual payoffs, and can easily be swayed by market trends and media hype around certain well-publicized firms. But even skilled, institutional investor can fall victim to mispricing and irrational market sentiment. In theory, investors should rationally make their decisions after performing a fundamental analysis and buy undervalued stocks and sell overvalued ones, which corrects any mispricing. While all valuation models require some subjective assumptions that may not come to fruition, some models require far more of these subjective assumptions than others, and many commonly used models rely on future payouts such as dividends that are unpredictable or nonexistent for startups (Damodaran, 2009).

Since 1995, new academic attention has been paid towards the theory of residual income valuation (RIV) as an improved method to analyze and derive a fundamental valuation of securities and companies. While residual income valuation dates back to Preinreich (1938), the concept was neglected in both academia and valuation practice until Ohlson (1995) gave it new attention. Since then, a number of studies have been produced studying residual income and comparing its performance to other valuation models (Bernard, 1995; Sougiannis, 1998; Penman, 2005; Cogliati et al, 2010; Johansson & Lengholt, 2017; Anesten et al, 2020). Furthermore, other studies have analyzed the usefulness and accuracy of the residual income model when applied to specific situations, such as the ability to explain profit expectations on the Stockholm Stock Exchange during a market peak and trough (Byrge & Wardeus, 2010) or ability to predict the offer price of a firm undertaking its initial public offering (Curtis & Fargher, 2003).

The general consensus of these studies, among others, is that residual income valuation tends to outperform a multitude of other commonly used fundamental valuation models in a variety of situations, and is generally more accurate in arriving at an accurate valuation for a security or for an entire firm. If investors are truly rational, we can assume that the residual income model may be used by investors to perform their valuation. And if stock prices are based upon rational valuations, we can expect to use the prices as a starting point to derive what investors' expectations were at the time of valuation. Such an analysis presents an interesting opportunity to explore the market's profitability expectations of an important and booming sector of the economy like startups in a unique region, and further test the theories of efficient markets against critiques from the realm behavioural finance. One of the key financial evaluation ratios is the return on equity ("ROE"), which measures how efficiently a company uses the capital invested in it to generate a return.

The purpose of this thesis is to evaluate the implied profit expectations for startups, with the following research question:

"How reasonable are profit expectations for publicly listed Nordic startups?"

To achieve this, we use a reverse-engineered version of Ohlson's (1995) residual income valuation model to back out the return on equity rate that would be required to justify the share price of these startups two years after their IPO, and compare to the historical average return on equity of their industry category peers. Unlike traditional valuation models that rely on historical and forecasted dividend payouts to arrive at a fundamental value of the firm, residual income valuation can in theory be applied to firms that are loss making, have never paid out a dividend, and are unlikely to pay one out for the foreseeable future, thus theoretically allowing startups to be modelled and their expected profitability to be judged. However, the nature of startups with high historical growth and unpredictable future growth means that we still have to make some subjective assumptions when modelling. Furthermore, our model is limited to the Nordic market over the 1998 - 2017 period and accordingly, results may not be fully applicable to different markets, company types, or time periods.

2. Research philosophy

Before describing our research approach, it is important to understand the assumptions that underlie and influence our research process.

First and foremost, corporate valuation is driven by a number of complex causes that can only be partially understood. Given the complexity of the topic, it is impractical and infeasible to capture all the fundamental dynamics that underlie valuation (Olsen, 2019). Accepting this, we must make a number of simplifying assumptions while conducting our study, which takes our model and research down a certain path that eliminates a number of other equally valid but more complex paths and thus, affects our conclusion. In order to have a sound foundation for our conclusion, we use a wide range of external theoretical and empirical sources in combination with our own testing of assumptions when no external sources can be found.

"Price is what you pay, value is what you get" – Warren Buffet

The distinction in the above quote between the mere price of a share of a company and an actual fundamental valuation of that share confirms the notion that valuation is a subjective estimate based on incomplete understandings and cannot objectively be observed (Cornell & Damodaran, 2014), while price is a product of supply and demand. To best possibly obtain an understanding of the relationship between the reported accounting information in combination with the residual income valuation (RIV) and the resulting market prices for startups, we seek to preserve as much objectivity as possible throughout the study and bring in as many sources of data and theories as possible. This reliance on multiple sources will make it less likely that misleading interpretations will be made, but cannot eliminate such interpretations entirely.

3. Literature review

Accurate valuation of equities is of utmost importance to analysts and investors who seek to create value, allocate resources effectively, and understand what the market demands of them. Nyborg & Mukhlynina (2016) find that the DCF method is the most widely used valuation model used by analysts and investors around the world, which is backed up by regional studies (Penman, 2001; Curtis & Fargher, 2003; Cassia & Vismara, 2004; Demirakos et al, 2004; Cogliati et al, 2010; Mumtaz & Smith, 2015), and usually paired with relative valuation as a "sanity check" (Roosenboom, 2007). It is thus safe to assume that DCF and relative valuation are also very likely the most commonly used valuation models in the Nordics as well. Other methods that are discussed heavily in academia but not as widely used in valuation practice include the Dividend Discount Model (DDM), Residual Income Valuation (RIV), and Abnormal Earnings Growth (AEG) model.

Following in the vein of Damodaran (2009) and improper valuation of startups using the standard DCF valuation model, other studies have confirmed that analysts are too optimistic regarding cash flows (Purnanandam & Swaminathan, 2002; Cogliati et al, 2010; Mumtaz & Smith, 2015). Specifically, Purnanandam & Swaminathan (2002) conclude that firms undertaking their IPO are overvalued by 50% compared to industry peers when using DCF valuation, Cogliati et al (2010) calculate mispricing on average of 74% while Mumtaz & Smith (2015) find an even more extreme overvaluation tendency clocking in at 81% on average.

A key assumption that underpins the majority of widely used valuation models is that the value of a share is equivalent to the present value of all dividends that will ever be paid out to the owner(s) of the share (Ohlson, 1995). This assumption is the basis of the DDM model, from which the DCF and RIV models are derived. Theoretically, all valuation models that are forecasted to infinity under this assumption should result in the same fundamental value; however, once a truncation point is introduced into the models, the fundamental values generated diverge sharply (Penman & Sougiannis, 1998). However, a wealth of previous research empirically demonstrates that the Residual Income Valuation (RIV) model performs better compared to other valuation models in determining the realized fundamental value of a share; this conclusion is what underpins our choice of model for backing out and evaluating the expected return on equity.

There is a need for greater understanding of the market expectations for startups going public, and the demonstrated superiority of the RIV model potentially offers a solution in this area. But to understand why the RIV model is superior, it is first important to understand where other valuation models fall short, as well as the RIV model itself and where it outperforms other valuation models.

3.1 Weaknesses of traditional valuation models on startups

3.1.1 Dividend discount model (DDM)

DDM is one of the simplest valuation models (Damodaran, 2012), but has been questioned over the past 30 years, since critics argue it merely focuses on *distribution* of value and not the *creation* of value. Miller-Modigliani's dividend irrelevance principle (1961) nullifies the traditional DDM model, as a firm's value is unaffected by the choice between distributing money as dividends or using retained dividends to finance new investments (Norrman & Rahmn, 2016). Furthermore, the key Gordon Growth Model assumption can only apply to companies expected to grow at a fixed growth rate for the foreseeable future in steady state, and cannot be applied to companies with changing growth rates (Gordon, 1959), which negates its usefulness to startups who see uneven and often extremely high growth rates.

Finally, most startups undertaking their IPO have a total lack of dividend payout history, making DDM modelling virtually impossible as this would require highly subjective and uncertain predictions of future dividends.

3.1.2 Abnormal earnings growth (AEG) valuation

AEG originates as an attempt to improve on the RIV model by discarding the CSR assumption, yet it still underperforms when subject to empirical testing conducted by Penman (2005), who found that it magnifies unsustainable earnings growth via the Gordon Growth Model. Previous research demonstrates that AEG recommends a sell signal for stocks that have the best performance, since companies that have high growth early on will then be forecasted to have negative abnormal earnings in the terminal value due to extreme mean reversion of ROE. AEG reads that high initial profitability means that a company is overvalued, when this may not actually be the case (Johansson & Lengholt, 2017). AEG furthermore relies on uncertain projections of future earnings (Penman, 2005), which can be very difficult to project for young startups in an expansion stage with low or negative earnings and a high probability of failure.

3.1.3 Relative valuation

Using relative valuation and relying on valuation multiples is also problematic. All valuation multiples have to be scaled to some common measure using important financial figures such as earnings, book value, and revenues, but these are usually lacking in a very young firm. Such firms are likely to report net losses, which means multiples such as P/E ratio and EBITDA multiples cannot be computed. The book values are also likely to be small due to the firm's short life and hence are not reflective of the amount of capital invested in the firm. Revenues once again can be small or even nonexistent (Damodaran, 2009). And even when a comparable firm that is publicly traded can be found, they very likely have different risk profiles, cash flows, and growth rates, further complicating the picture (Damodaran, 2009). Curtis & Fargher (2003) specifically compare relative valuation to RIV and empirically demonstrate that the RIV model with simplified growth assumptions outperformed every relative valuation measure in determining the offer price of a startup undertaking its IPO, but do suggest that relative valuation can still be useful when paired with direct valuation via the RIV model.

3.1.4 Discounted cash flow (DCF) valuation

The single most pressing issue when attempting to value startups with a DCF valuation model is the lack of history that these startups have, which complicates projecting cash flows from existing assets and growth assets, as well as determining an appropriate discount rate. The standard approach to valuing cash flows from a company's existing assets is to use the current and historical financial reports to estimate the future cash flows, but the lack of history when dealing with a young startup can make this difficult, if not outright impossible.

Estimating how earnings will evolve as revenues change is also a challenge due to this lack of history (Damodaran, 2009). However, even when a firm eventually generates free cash flows, the DCF model does not recognize value added other than value involving cash inflows; rather, the DCF model treats investment as value-destroying, even though these investments will generate even greater future cash flows and thus greater value.

3.2 Residual income valuation (RIV)

Traditional financial statements, such as the income statement, are structured in such a way as to conclude with the net income available to the firm's owners. While the cost of debt is reflected in the net income figure, as the debt interest expense is deducted before arriving at the net income number, the income statement does not account for any sort of cost of capital (e.g. dividends). Dividends and other transactions with owners are indeed stated in the statement of changes to owners' equity; however, there is no information explicitly provided that can help an analyst determine the required rate of return for capital providers, which represents their opportunity cost for investing in the firm, i.e. while the debt interest rate can be calculated or found in a stated loan contract, there is no return on capital rate provided to help calculate the opportunity cost (Szydelko & Biadacz, 2016). Taking opportunity cost into account is important from an investment perspective, since a firm may post an accounting profit, but once opportunity cost is considered, the firm may not be economically profitable. It is here that the concept of residual income provides a solution to analysts and investors in determining whether an investment is economically profitable by subtracting a charge for equity from net income (Ohlson, 1995).

A simplistic iteration of the residual income concept is as follows:

$$RI_t = Earnings_t - BVOE_{t-1} * r_e \tag{1}$$

Residual income valuation traces its origins to Preinreich (1938), who was the first to formally posit that capital values were a function of an asset's book value and earnings, less a required rate of return, and was further expanded upon by Edwards & Bell (1961) and Peasnell (1982). The RIV model originates from the DDM model and is based upon the same theory, but is reformulated to focus on book value of equity (BVOE) and return on equity (ROE). In contrast with DDM's focus on the distribution of value, the RIV model focuses on value-creation (Norrman & Rahmn, 2016). The RIV model is widely recognized at being better at explaining stock prices than other models, and this is attributed to the fact that RIV anchors itself on book values, whereas other models are more dependent on future payoffs that are more uncertain (Johansson & Lengholt, 2017; Penman, 2005).

A basic mathematical formula for residual income valuation is as follows:

$$V_0 = BVOE_0 + \sum_{t=1}^{T} \frac{(ROE_t - \rho_t) * BVOE_{t-1}}{(1+\rho)^t} \tag{2}$$

where:

> V_0 = value of owners' equity, which excludes any dividend declared but not yet issued, and includes any new issue of shares at time t = 0
>
> ROE_t = expected Return on Equity, where t denotes the specific time period in which the return is realized
>
> $BVOE$ = the opening book value of equity, where *t-1* denotes the period prior

ρ = the cost of equity capital

Residual income valuation relies on accounting information that is readily available and can easily be applied to companies that do not pay dividends or have unpredictable dividend payment patterns, have uncertain cash flows, are difficult to forecast terminal values for, and do not have positive short term free cash flows but will generate cash flows and pay dividends in the future (Stowe et al, 2014).

3.2.1 Key assumptions of the RIV model

Two original, fundamental assumptions underlie the RIV model:

1. Firm value equals the present value of all future expected dividends

2. The Clean Surplus Relationship (CSR) holds

If these two assumptions hold, one can mathematically derive RIV from the DDM (Ohlson, 1995). Ohlson (1995) further expands on the original RIV model assumptions by introducing a third assumption about linear information dynamics of residual income, where residual income approaches zero in the long run. A further fourth implied assumption in RIV is the going concern assumption, where residual income can be forecasted to infinity (Norrman & Rahmn, 2016).

However, the forecast approach to residual income valuation, which disregards linear information dynamics and instead forecasts residual income over a set forecast period and then calculates a terminal value, is the primary method of using the RIV model (Ohlson, 1995), thus we will not discuss linear information dynamics in this paper.

Assumption 1: Firm Value Equals Present Value of All Expected Future Dividends

Investors receive future cash flows from their investments in two ways: cash dividends or a potential capital gain when the share is sold. However, RIV ignores the potential future capital gain, as Berk & DeMarzo (2014) demonstrate that the amount of time a share is held is actually irrelevant. With the going concern assumption, a share can be held forever and thus, the investor receives only cash dividends as their future cash flow (Berk & DeMarzo, 2014).

Assumption 2: The Clean Surplus Relationship Holds

CSR makes the RIV and DDM models mathematically equivalent and allows dividends to be substituted with earnings (ROE) and book value of equity (BVOE) by implying that changes in BVOE are explained by current year's earnings and dividends (Ohlson, 1995). It further implies that all changes in book values (except transactions with owners) must pass through the income statement.

$$BV_t = BV_{t-1} + Earnings_t - Dividend_t \tag{3}$$

Even though CSR is assumed to hold in the RIV model, it rarely holds in real life (e.g. when the number of common shares outstanding changes through a stock issue or repurchase). To avoid violating CSR, other comprehensive income (OCI) should be used instead of mere net income. However, assuming CSR holds is still a reasonable assumption for valuation purposes (Lundholm, 1995).

3.2.2 Terminal value in the RIV model

The residual income model, shown in formula (2), is overly simplistic and runs into a number of issues which require a series of further adjustments to improve its accuracy. First, the formula is valid as it stands if the firm is assumed to continue operating into perpetuity. While the going-concern assumption is fairly fundamental in accounting, for valuation purposes forecasting into infinity is impractical. Hence, a truncation point in the valuation is assumed and a terminal value is introduced to simplify financial projections (Skogsvik, 2002).

$$V_0 = BV_0 + \sum_{t=1}^{T} \frac{(ROE_t - \rho_t) * BVOE_{t-1}}{(1+\rho)^t} + \frac{V_T}{(1+\rho)^T} \tag{4}$$

where:

V_0 = value of owners' equity, which excludes any dividend declared but not yet issued, and includes any new issue of shares at time t = 0

ROE_t= expected Return on Equity, where t denotes the specific time period in which the return is realized

$BVOE$ = the opening book value of equity, where *t-1* denotes the period prior

V_T = book value of owners' equity in steady state

ρ = the cost of equity capital

3.2.3 Adjusting for conservative accounting bias

A third adjustment that must be made is to account for the distortions introduced by accounting standards that cause the accounting value of equity to deviate from the true economic value of the firm's equity (Skogsvik, 2002). Since 1940, accounting rules worldwide have generally followed the principle of historical cost accounting and accounting conservatism, where expenses are recognized immediately, revenue recognition is delayed until actually earned, and assets and net income are generally understated (Paton & Littleton, 1940). Financial statements are supposed to present a firm's financial performance and position in a fair and structured way, yet accounting conservatism complicates this goal. In practice, this means that book values and earnings are on average understated, and hence do not accurately reflect their true economic values. The difference between *earnings under conservative accounting* and *earnings under unbiased accounting* is the conservative measurement bias (Penman & Zhang, 2002).

Although conservative accounting is considered a prudent way of reporting, it usually creates higher returns on book values than what they should be under neutral accounting (Penman, 2013). This happens to an extreme degree in inflationary environments, where earnings grow quickly while asset values do not (Schuster et al., 2017). This is extremely problematic for analysis ratios such as Return on Assets, as the numerator (net income) grows while the denominator (total assets) does not, since earnings will artificially increase due to inflation and are not "real" earnings (Hellman, 2019).

Penman (1998) determines that a great deal of value in an equity valuation model can be attributed to the terminal value and this value can also be affected by conservative bias. He introduces a "measurement error parameter", denoted by the symbol *K*, which gives different weights to earnings-respective book values in the terminal value. Skogsvik (1998) shows that if a forecast horizon is long enough, then the goodwill figure will consist of nothing but the conservative bias. The numerator in the terminal value can then be rewritten as $BVOE_T$ * *K-value*.

Penman (1998) and Skogsvik (1998) both demonstrate the necessity in detecting conservative measurement bias. At the same time, Runsten (1998) developed a separate measure of industry-specific permanent measurement bias (PMB) coefficients to help unskew these biased numbers, reasoning that companies in different industries are affected differently by accounting bias, and thus will have different levels of accounting bias, thus it would be inappropriate to use one measure to encompass all companies in all industries. Runsten's coefficients, called "q-values", were developed upon a sample of listed Swedish firms between 1966 and 1993 across 15 industry categories. This q-value is incorporated in the RIV model's terminal value, where the industry-relevant q-value is multiplied by the book value of equity at the truncation date to obtain the adjusted book value of equity.

$$V_0 = BVOE_0 + \sum_{t=1}^{T} \frac{(ROE_t - \rho) \times BVOE_t}{(1+\rho)^t} + \frac{(q \times V_T)}{(1+\rho)^T} \tag{5}$$

where:

V_0 = value of owners' equity, which excludes any dividend declared but not yet issued, and includes any new issue of shares at time *t* = 0

ROE_t = expected Return on Equity, where *t* denotes the specific time period in which the return is realized

$BVOE_{t-}$ = the opening book value of equity, where *t-1* denotes the period prior

V_T = book value of owners' equity in steady state

q = the permanent measurement bias for the relevant industry as calculated by Runsten (1998)

ρ = the cost of equity capital

Runsten's q-values can also be modified by Skogsvik's (1987) probability of failure by incorporating the p(fail) into the model by using the cost of equity capital adjusted for the probability of failure.

These adjustments (adding a terminal value, incorporating the probability of failure, and adjusting the book value of equity in the terminal value for the permanent measurement bias) help improve the accuracy of the residual income model. Furthermore, these adjustments which are incorporated into this study were developed with data samples developed specifically from the Nordic region. This geographic consideration is relevant in our selection of conducting our study in the Nordic market to conserve the best fit of these adjustments.

3.2.4 Benefits of the RIV Model compared to other models

The RIV model outperforms the DDM and DCF models with regards to valuation of startups and mature firms primarily because RIV does not rely on speculations about cash flows or earnings, but rather purely on forecasts of the growth of book value of equity, which can be observed today (Johanson & Lengholt, 2017). Additionally, it does not require the same historical figures that the DDM and DCF models require that are often scant or totally non-existent for young firms. Bernard (1995) lends further credence to the preferability of RIV over DDM and DCF with regards to startups, in that the RIV model's focus on forecasted book values empirically outperform dividend forecast-based models.

The RIV model also tends to outperform the AEG model, both with startups and mature firms, because the terminal value in the RIV model does not compose as much of the final value as terminal value as other models do; this is beneficial as the terminal value contains a great deal of subjectivity and assumptions, which can cause major value changes based upon small changes in analysts' assumptions (Stowe et al, 2014). With regards to relative valuation, the RIV model is preferable to the relative valuation method because relative valuation is merely a "sanity check" and based upon imperfect comparisons, whereas RIV is a fundamental valuation model that focuses on actual value creation and accounting numbers (Johansson & Lengholt, 2017).

Finally, the RIV model is the only reliable model where the return on equity is explicity stated and forms a key driver of the model. According to Runsten (1998), the return on equity (ROE) is a better performance variable rather than absolute earnings, since ROE is used as a prominent performance indicator among Nordic listed companies. This makes the RIV model the ideal model to gauge the profit expectations of the Nordic market.

Table 1: Empirical Comparison of Valuation Models

Valuation Model	Formula	Traits of Model/Method	Failures/Weaknesses	Author(s) comparing to RIV Model	Comparison Result
DDM	$V_0 = \sum_{n=1}^{\infty} \frac{D_n}{(1+r)^n}$	- Simplest model - Focuses on PV of dividends paid out - Expected growth rate best for mature firms	- Startups often do not pay dividends for a long time - Focus on value distribution and value creation	Bernard (1995); Sougiannis (1998)	RIV model superior
AEG	$V_0 = \frac{EPS_1}{\rho_e} + \left(\sum_{t=1}^{T} \frac{1}{(1 + \rho_e)^t} z_t + \frac{\frac{Z_T}{\rho_e - g_{ss}}}{(1 + \rho_e)^{T-1}} \right)$	- Attempted improvement on RIV model - Based upon EPS - Eliminates CSR assumption	- Magnifies unsustainable growth - Gives sell signal for stocks with the best performance - Relies on uncertain future earnings	Penman (2005); Johansson & Lengholt (2017); Penman (2000)	RIV model superior
Relative	*Not formula based*	- Easiest method - Helps give rough valuation - Helps compare firm to similar firms in industry	- Critical information missing with firms with no/short history - Firm in same industry may have completely different risk and financial structures	Curtis & Fargher (2003)	RIV model superior
DCF	$V_0 = \sum_{n=1}^{\infty} \frac{CF_n}{(1+r)^n}$	- Most widely used model in valuation practice - Based on future free cash flows discounted to present value	- Lack of history makes this difficult - Too many subjective assumptions - Complicated claims to equity difficult to model - Forecasts are highly uncertain	Sougiannis (1998); Cogliati et al (2010); Francis et al. (2000)	RIV model superior
RIV	$V_0 = BVOE_0 + \sum_{t=1}^{T} \frac{(ROE_t - \rho) \times BVOE_t}{(1+ \rho)^t} + \frac{(q \times V_T)}{(1 + \rho)^T}$	- Focuses on changes in book value of equity	- Relies on the CSR theory - Unproven with regards to startups		

3.3 Startup characteristics

3.3.1 Definition of startup

The term "startup" became a description of a particular kind of firm starting in the 1980s (Cockayne, 2019). Prior to that, "startup", though it was rarely used, described the early stages of any firm's activity in general terms. The term startup has expanded substantially since the 1980s, both in terms of its applicability of meaning, and the geographic contexts to which it applies[3]. Today, "startup" has become a buzzword and while there is a wealth of prior literature about startups, there is not always consensus on a single consistent definition. Cockayne (2019) analyzes the definition of startup and notes that no academic accounts found systematically define startup. However, the myriad definitions and criteria for a firm to be considered a startup used in different articles, media and public policy papers often overlap and contradict one another. Achletiner (2018) conversely describes a startup as a company in the early stage of the business lifecycle with a high degree of innovation and seeks capital resources for further growth. Furthermore, Achleitner notes that the defining characteristic of a startup in the early stage is the level of innovation and outstanding growth potential of the firm. The focus on the level of innovation is important in defining a startup, because merely focusing on young firms in general would be too expansive a definition; such would include more mundane businesses such as a beauty salon or restaurant that may indeed have short duration of operations, low revenues, and low employee headcount, but lacks the disruptive innovation that more accurately captures the essence of a startup. Similarly, in the course of Damodaran's (2009) paper, he provides valuable insight on the definition of what constitutes a startup. He lays out a simple life-cycle progression of young companies that begins with "idea companies", which have no revenues and only operating losses, followed by "startup companies", who have increasing revenues but also increasing losses, and finally ends "second stage" companies, who finally begin to show positive earnings and move towards profitability.

However, exactly what is meant by "early stage" and "level of innovation" is not defined and lacks clarity around precisely how growth should be measured (e.g., in terms of revenue, profit, number of employees, number of clients, numbers of users, etc. all of which could also be seen as a question of firm size), and the time period over which such measurements should be examined. Eurostat and the OECD define young, high-growth business by annual growth of

[3] Based on using Google Ngram, the usage of word "startup" has increased tremendously over the past 20 years

higher than 20% per annum, over a three-year period should be considered as high-growth companies, with growth being defined either by revenue or number of employees. However, Eurostat and OECD do not call such firms “startups” and this definition may still exclude firms that are self-financed or in their early stages.

From a quantitative perspective, the European Commission (2016) defines a small or medium-sized enterprise (“SME”) as making less than €50 million in revenue per year. While a startup is always an SME, an SME is not always a startup due to some of the qualitative characteristics associated with startups: a startup is young, innovative, and has potential for growth, while an SME can be very old, stable, and engage in non-innovative production of goods and services. Since Sweden is a part of the European Union, the European Commission’s revenue-based definition of an SME is an approximate best fit.

Damodaran (2009) also uses duration of operations as a rough measure for defining a startup, and Robehmed (2013) states that startups cease being startups after about three years in business. However, defining a startup by how long it has been in operation is also both capacious and vague, as it is often difficult to formally define a firm’s true beginnings since a year of founding is not always the same year of the start of operations (Cockayne, 2019). Another key definition, as mentioned by Achleitner (2018) and Cockayne (2019), is based upon the type of funding that startups pursue. A priority of the startup’s investors is to ideally grow exponentially and reach an “exit event”. This “exit event” could mean several things, including acquisition or IPO, but the idea behind the exit event is to procure enough capital and/or grow the company’s value in order to deliver a return to investors on the capital they invested in the firm. This definition of startup is however solely financial, organized around singular accumulation- and growth-based goals of limited partners, and often conflicts with other qualifying factors such as size and duration of operations.

Synthesizing the myriad definitions and criteria to define a startup, it is clear that definitions of startups often contradict one another, and that “startup” is a rather nebulous concept that defies straightforward definition, and there is no exhaustive list of characteristics to qualify as startup. Cockayne (2019) shows that the assumption of a single, clear definition may be limiting in research and practice, and while the term “startup” is taken up in academic and non-academic contexts, it remains nebulous and undefined in either.

3.3.2 Desirability of startups

While a clear and concise definition of what constitutes a startup is difficult to determine, it is not so difficult to understand what startups do, how they benefit society, and why so much attention has been paid to them from a standpoint of their desirability.

First and foremost, startups are seen as the best creators of innovation, economic growth, employment creation, and generators of prosperity as the world economy has transitioned from the industrial era to the post-industrial knowledge economy, which is based upon knowledge-intensive economic activities that are based upon and generate a high degree of innovation (Stam & Garnsey, 2007; Kassicieh, 2010). Startups are a major source of private sector investment regarding research and development as they seek to develop, launch, and then produce a new product or service or new method of doing business. The new products startups offer help to create new markets and stimulate further investment from competitors. This competition improves overall efficiency in the broader macroeconomy as established firms are forced to compete with a startup competitor and attempt to defend its economic position by further improving their product or offering it at a better price (Dejardin & Frtisch, 2011; Koellinger & Thurik 2012, Szarek & Piecuch, 2018).

Employment growth is also a major reason why startups are considered desirable by policymakers (Stam & Garnsey, 2007). While larger, mature firms tend to have a boom-bust employment pattern that follows macroeconomic trends, startup firms tend to have more consistent employment growth patterns as they progress through the lifecycle of a firm and grow in size. And although the failure of a startup firm entails employment destruction, as would the failure of a mature firm, the net employment impact of startups that survive is positive, both directly from the individual firm itself, but also indirectly from the competition and copycat competitors it generates. Kane (2010) estimates that net employment creation from startups over the 2000s decade in the United States amounted to some 3 million positions of employment. Hornell & Litan (2010) further estimate that startup firms retain 80% of their net employment creation after 5 years and still retain 68% of jobs created after 25 years on average despite only 20% of startup firms surviving that long, by which time they have long since ceased to be startups and have reached maturity.

The combination of high failure rates and high employment retention indicates that successful startup firms continued to grow after leaving the startup stage of their lifecycle. Thus, even despite high fail rates, the macroeconomic payoffs for startups that find success are enormous.

3.3.3 Publicly listed startups

As previously mentioned, a priority of the startup's investor is to reach an "exit event". It is important to understand that an "exit event" is not an event when a startup ceases being a startup but rather an event when investors such as venture capitalists exit their investments and convert their share-based wealth into an actual cash payout (Stoyanov, 2020). One of the "exit events" is an initial public offering ("IPO"), with the primary reason for undertaking is the desire to raise equity capital for the firm for future investment while also entering a public market in which founders and other shareholders can convert some of their wealth into cash by selling their shares in the firms (Mason & Botelho, 2014). Zingales (1995) observed that it is much easier for a potential acquirer to spot a potential takeover target when the target is publicly traded, since information on the target firms is readily available. By going public, entrepreneurs thus help facilitate the acquisition of their company for a higher value than what they would get from an outright sale.

Alternatively, Black and Gilson (1998) point out that entrepreneurs often regain control from venture capitalists in venture capital-backed companies upon IPO. Thus, many IPOs are not so much exits for the entrepreneur as they are for the venture capitalists. Ritter (2020) finds that 75% of the IPOs from 2001-2019 were either venture capital- or buyout-backed, with the majority of firms undertaking an IPO being young companies, and furthermore noted an increase in the share of startups undertaking IPOs in recent years.

A startup's valuation is helpful in determining how much financing can be raised, since a higher valuation implies a greater amount of funding. While venture capitalists base their returns on the difference between the initial investment valuation and the final exit proceeds, entrepreneurs determine potential dilutive effects and control right transfers based on the same underlying valuation (Cumming & Dai, 2011; Hsu 2004; Zheng et al., 2010). Valuation is a main element of financial management, and startup valuation is a key component of the free enterprise system, which constitutes a main driver of any economy. Thus, coming up with a valuation for a well-established firm already inhibits multiple stumbling stones. The task of valuation for a young business venture, consequently, is even more difficult as the typical startup lacks any reliable projection metrics or financial history.

3.3.4 The Nordic market

The Nordic countries excel in promoting the formation of new businesses, on a level that is remarkable for a region of roughly 25 million inhabitants. While all four Nordic countries studied here excel in business creation and producing world-famous firms, Sweden in particular is considered as one of the most startup friendly countries in the world[4]. Stockholm, for example, produces the second highest number of billion-dollar tech companies per capita, after Silicon Valley in the United States (Wharton School of Business, 2015).

The roots of the Nordic countries' economic prosperity and vibrant startup scene have been heavily studied over the past 20 years, and a wide body of literature have cited a variety of factors such as low corruption, generous welfare states, strong education systems, high social trust, entrepreneurial culture as contributing to this success with innovative startups (Warhuus & Basaiawmoit, 2014; Dvouletý, 2016). All four countries regularly place in the Top 15 in rankings of entrepreneurial culture by various business magazines (US News Best Countries, 2017). Sweden, Denmark, and Finland are three of the just six countries in the world where government investment in research and development exceeds the recommended 3% of gross domestic product, a critical component in supporting an entrepreneurial and innovative environment. These investments in research and development pay off, as Sweden, Denmark, and Finland all place in the top six of countries with the most patents filed per capita (OECD, 2013). Sweden and Finland in particular are noticeable with regards to the percentage of value added to their private sector economies by the information and communication technology sector, while Sweden and Denmark are two of the largest producers of software technology in the world, both beaten out only by the United States (OECD, 2013). All four Nordic countries have some of the highest rates of household access to personal computers, giving citizens a natural proclivity towards and comfort with technology from a young age.

All four Nordic countries offer highly educated populations, social and political stability, and a high degree of cultural openness to new, innovative ideas (Wharton School of Business,

[4] Startup Blink article (2020), Hansen & Company (2020), Wharton School of Business, University of Pennsylvania (2015)

2015). With this strong environment that supports entrepreneurship and innovation, it is little surprise then that the Nordic countries produce such a disproportionate number of startups for a region of its size.

3.4 Contribution

This paper will try to establish a bridge between the RIV method and startups by studying the profit expectations on startups. As there are wealth of previous literatures of RIV model on long established publicly listed firms, despite to its superiority over other valuation methods, according to our findings, there is a clear consensus that lacks the usage of RIV model as valuation methods on startups. The RIV model enables a fundamental valuation that focuses on reported accounting numbers that are publicly available in the market (Frankel & Lee, 1998), which makes testing the efficient markets hypothesis and market expectations feasible. This paper therefore presents the opportunity to contribute to not only RIV literature, but also to startup literature.

4. Research design

4.1 Data Sample – Projected historical information

4.1.1 Identification of startup companies

As mentioned previously in Section 3.3, there is not always a consistent definition of what exactly constitutes a startup, but coming up with an appropriate definition is critical to obtain an appropriate sample of firms. Among the previous literature reviewed, there seems to be a general consensus that size (in terms of revenue), duration of operations, and low or negative net income are the important factors in determining whether a firm is a start-up or not. However, rarely are quantitative terms such as revenue, duration of operations, and net income defined in concrete numbers, but rather are discussed in vague terms, e.g. “low” revenues and net income.

As mentioned above, the European Commission’s guidelines define an SME as having less than €50 million in revenue per year. However, since a key trait of startups is their ability to grow, and also to obtain an adequate sample size, we set our revenue criteria at double this amount: €100 million in annual turnover, or approximately 1 billion Swedish Kronor per year.

Net income or loss, like revenue, is also poorly defined. To keep our sample in line with startups having low to negative income, we choose to set a low net income threshold at 10 million Swedish Kronor or less. We include firms that are making a small profit since we are primarily studying late-stage startups firms, and hence it is reasonable to assume that a small number of these firms may have reached profitability, which also allows us to capture a greater sample size with some diversity of net income or loss figures.

Therefore, for the purposes of this paper, we will include listed firms in Nordics that meet all three of the following criteria:

1. less than 10 years of duration upon IPO, defined as companies that have limited history
2. firms with less than 1bn SEK in revenue, to capture a greater sample of diverse companies (e.g. unicorns)
3. firms with low (less than 10m SEK in net income) or negative net income

Our sample consists of 109 companies (Appendix XI) taken from the S&P Capital IQ database. The firms are based in the Nordics and undertook their IPO between 1998 and 2017 when they were no more than 10 years old at the time of their IPO and have at least 2 years of financial data available to conduct our study. “The Nordics” are defined for the purpose of this study as including Sweden (87), Finland (4), Norway (8), and Denmark (10); Iceland is excluded due to the vastly different economic structure present on the small, distant island-country compared to the more industrialized continental Nordic countries.

Table 2. Defining a Startup

Author	Year	Definition Criteria
Damodaran	2009	Duration of operations, revenues, net losses, ownership structure
Laitinen	2017	Duration of operations
Cockayne	2019	Duration of operations, employee headcount
Robehmed	2013	Duration of operations, level of innovation, employee headcount
Achleitner	2016	Duration of operations, level of innovation, growth potential
Goldman Sachs	2019	Duration of operations, revenue, sales growth
Salamzadeh & Kesim	2015	Duration of operations, revenue, capacity for innovation
Reinfeld	2018	Duration of operations, level of Innovation, negative free cash flow or net income
Olsen	2018	Duration of operations, revenue, loss making
Hamburg Chamber of Commerce	2018	Duration of operations, level of innovation, potential for growth
Sanyal & Mann	2010	Duration of operations, employee headcount

Count: Duration of operations (11), Revenue/Income (5), Innovation (5), Employee Headcount (3), Growth Potential (3), Ownership Structure (1)

4.1.2 Empirical and theoretical foundation

The theoretical foundation of this paper is based upon an established valuation framework: the residual income valuation model as presented by Ohlson (1995) and its implications analyzed in a start-up valuation perspective.

The empirical data used in the course of this study is collected from Capital IQ, a research division of Standard and Poor's. From Capital IQ, an initial sample of 967 firms that have undertaken IPO since 1997 in the Nordics was collected, and after further screening using the stricter criteria from our definition of a startup, the final result sample numbered some 161 firms.

In order to avoid narrowing our sample too much and losing valuable data observations, but at the same time not incorporate extreme, unrepresentative, or otherwise atypical values, we have followed some pre-specified application principles for our model: first, historical ROE is based on firm-specific historical averages of the book return on owners' equity[5]. In the calculation of these averages, we excluded firms with less than two years of historical values of ROE_t. Furthermore, we excluded firms with average value of ROE_t that were lower than -150% or higher than +150%, since values that fall outside of these parameters are extreme even for startups (which usually have strongly negative ROE) and distort our sample and final conclusion[6].

Secondly, we excluded firms with negative book value on equity at point in time, as these firms also distort the sample and results since this is an atypical situation that occurs due to a number of complex reasons, such as reliance on debt financing rather than new equity issues to cover losses, or a high number of patents that have not yet generated their full potential future returns. Thirdly, we excluded firms without available information on market capitalization, beta, and historical ROE since these are critical inputs for our model and analysis. Lastly, we excluded financial and real estate firms in line with Anesten et.al (2020), Byrge and Wardaeus (2010) and Fama & French (1992) since these types of companies often have complicated accounting methods, have high leverage, and require alternative valuation methods and adjustments that would reduce their comparability with the rest of our sample.

4.2 Base Case data sample – Forecasted future information

We choose to value our firm on December 30th of the year that falls two years after the IPO of the firm in question[7]. By moving the valuation date two years after the IPO is undertaken, this avoids the distortions in valuations caused by mispricing after IPO and gives time for share prices to correct back to more reasonable levels (Krigman et al, 1999; Lim & Hooy, 2010). Valuing all firms at the same date is important to maintain comparability, and December 30th being the last day of trading before the end of the year is a useful benchmark and aligns with many firms' final or penultimate day of operations before the year-end reports are finalized. Furthermore, no important monthly, quarterly, or annual reports are released around this day, which eliminates the chance that valuations could be affected by information announcements. We choose a valuation horizon of 10 years after the valuation date (12 years

[5] $ROE_t = NI_t/BV_{t-1}$
[6] Following in the footsteps of Anesten et al (2020), we set our upper boundary of average ROE at +150%. The lower boundary is set on -150% to include more sample as vast majority of startups have negative income. Startups with extremely negative ROE and can be refinanced through their equity investors (e.g. venture capital firms) and can survive such an extreme loss.
[7] e.g. if a firm went public in 1998, we value it as it we were present on December 30th, 2000 without any forward knowledge. Similarly, if a firm went public in 2014, we value the firm as if we were present on December 30th, 2016, and so on.

after going public) to give our firms enough time to fall to a more reasonable growth rate that would reflect the growth rate in steady state. This comparatively long horizon forecast falls in line with Laitinen (2017) and Cornell & Damodaran (2014), who determine that startups and young firms should have a longer forecast horizon to allow the firm to resemble how it would develop in steady state. Anesten et al (2020) also find that a longer valuation horizon improves the RIV model's accuracy by a substantial degree, giving us additional vindication to an extended horizon period.

4.2.1 Reverse engineering of the RIV model

In order to establish a measure of the implied ROE required to reach the prevailing stock prices two years after the IPO date, we have used the concept of reverse engineering. Assuming all other components in the residual income valuation formula are known, this allows us to reverse engineer the RIV model and determine the unknown variable (ROE_t) in the formula.

4.2.2 Return on equity in Steady state

With a vast body of research indicating that ROE tends to mean revert (Brooks and Buckmaster, 1976; Fairfield, Sweeny and Yohn, 1996; Laitinen, 2017), the ROE is forecasted to revert towards the ROE in steady state ROE_{SS}, over the explicit forecasting period. However, the reversion pattern is not always agreed upon. Fama & French (1992) use a linear decrease towards steady state, while Laitinen (2017) used a sample-wide regression pattern that saw sharp reversion towards steady state within the first two to three years, followed by a gradual reversion over the remaining few years until steady state was reached. Therefore, we have studied the historical pattern of startups for each individual industry group in developed markets such as the European Union and the United States to best match each particular industry's regression patterns and preserve applicability and accuracy. (Appendix I)

Since competitive forces should eliminate abnormal profitability over time, it is assumed that in the steady state there are only zero NPV[8] projects, i.e. firms can only invest at the required return and do not earn above or below it. However, due to conservative accounting, the book value of equity will not equal the market value of equity even in the steady state, whereby ROE in steady state will be greater than the cost of equity. Since all business goodwill will be gone

[8] Net present value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows over a period of time, hence, zero NPV means that the investment earns a rate of return equal to the discount rate

in a zero NPV market, only the permanent measurement bias from conservative accounting will remain. The ROE_{ss} is therefore estimated using the relationship between ROE, cost of equity, growth and permanent measurement bias.

$$ROE_{SS} = \rho_e + q_T(\rho_e - g_{ss}) \tag{6}$$

where:

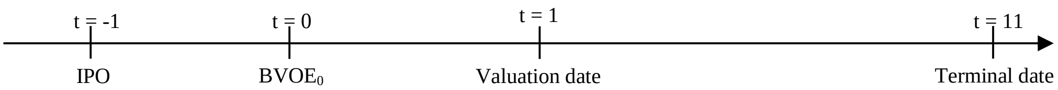
ROE_{SS} = return on owners' equity in steady state
ρ_e = cost of equity capital
q_T = permanent measurement bias caused by conservative accounting
g_{ss} = growth rate in steady state

4.2.3 Book value of equity – Base Case and additional tests

The valuation point in time for this study is two years after the IPO date. Since this paper aims to study implied ROE_t when t = 1, i.e., two years after the IPO date, we can set the IPO date as t = -1 and adjust the RIV formula (5) as:

$$V_0 = BVOE_0 + \sum_{t=1}^{11} \frac{(ROE_t - \rho_e) * BVOE_t}{(1+\rho_e)^t} + \frac{q * BVOT_{11}}{(1+\rho_e)^{11}} \tag{7}$$

Where IPO date is *t-1* and $BVOE_0$ is one year prior to the valuation date, therefore the variable is known for reverse engineering.



However, as $BVOE_t$ is unknown, we have obtained a comparable sample of firms that meet not only the same startup characteristic criteria but also the condition that they survived 12 years after the IPO date. As such, we can use the historical growth rate obtained from comparable firms to forecast our sample until steady state, t =11. As a Base Case, the comparable firms are obtained from the Nordic market and for an additional test, we have obtained comparable firms from US and a sample of developed countries[9] in European Union. Furthermore, for a robustness test to study whether other scenarios give us better results, we

[9] Developed countries include: UK, Germany, Belgium, Italy, Spain, Portugal, Netherlands, Switzerland, Austria and France

will use the average growth rate taken from the samples of developed countries in EU in addition to the Nordics, and take the average of all countries, using a constant growth rate set at 5% along with a linearly decreasing growth rate from 10% to 2%.

Table 3: BV of Equity growth rate tests

BV of Equity Growth rate Base Case

	T2	T3	T4	T5	T6	T7	T8	T9	T10	SS
Nordic	21.6%	20.1%	24.5%	-7.5%	12.6%	11.4%	10.5%	14.0%	11.7%	2.0%

BV of Equity Growth rate Additional test

	T2	T3	T4	T5	T6	T7	T8	T9	T10	SS
USA	9.0%	12.0%	14.8%	7.1%	6.5%	8.7%	4.7%	0.0%	-0.9%	2.0%
Europe	0.7%	4.0%	2.1%	6.2%	-0.8%	1.3%	-0.5%	11.6%	3.8%	2.0%
EU & Nordic	5.4%	7.1%	6.3%	3.4%	2.7%	3.5%	3.1%	5.9%	4.8%	2.0%
All	7.1%	9.6%	10.9%	5.5%	4.8%	6.4%	3.1%	3.9%	2.2%	2.0%
Constant	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	2.0%
Decrease	10%	9%	8%	7%	6%	5%	4%	3%	2%	2.0%

4.2.4 Cost of equity

The cost of equity is estimated using the capital asset pricing model (CAPM) of Lintner (1965) and Sharpe (1964). The critical inputs for the model are the beta, market risk premium, and risk-free rate (Penman, 2013), all of which have multiple alternatives with major implications for our conclusion, and this forces us to carefully consider and motivate our choices among the options we are given.

$$\rho_e = r_f + \beta(MRP) \tag{8}$$

where:

ρ_e = cost of equity capital

β = beta, i.e. non-diversifiable or systematic beta

r_f = risk-free rate (10Y government bond rate)

MRP = market risk premium

The estimate correct beta for each company, we have obtained beta from multiple sources[10] as well as estimated by regressing the stock returns against the market index. The market risk premium is set to 5.9% (Appendix X), per our average of the annual market risk premiums from Statista (2020), covering all four Nordic countries each year from 2011 to 2020. While our sample dates back to 2005, the market risk premium has remained remarkably steady in the Nordic region for the past several decades (Nordea, 2019; Nordic Council of Ministers, 2020). Furthermore, Francis, Olsson and Oswald (2000) heuristically set market risk premium to 6%, in line with our finding. The risk-free rate is proxied with a 10-year government bond rate available at valuation point in time (Appendix IX).

4.2.5 Industry specific accounting adjustments

Within the terminal value, the book value of equity is skewed by the permanent measurement bias that arises from the deviation of accounting values from their true economic values (Skogsvik, 2002). To correct for this, Runsten (1998) developed industry-specific measurements of this bias, which are known as “q-values”, which can be multiplied by each company’s respective book value of equity in steady state to obtain a more accurate valuation.

However, Runsten’s q-values were developed before the adoption of International Financial Reporting Standards (IFRS) in 2005 across the European Union, which fundamentally changed accounting principles by moving closer to market value-based accounting (Koleva et al, 2016). This change caused a lowering of the permanent measurement bias across the board, as differences between accounting and market values lessened (Johansson & Lengholt, 2017); however, Runsten’s q-values have not been reworked since they were first developed in 1998. This change brought about by IFRS has implications for our study, as many Nordic startups in our sample operate in the healthcare and tech sectors, which tend to have intangible assets and leases which were most impacted by the adoption of IFRS and subsequent amendments. While we include one firm in the paper & pulp industry in our sample, further analysis of the firm’s balance sheet indicates that it has negligible amounts of biological assets, thus the accounting standard IAS 41 - Agriculture does not affect our sample.

However, we do have one deviation from Runsten’s (1998) original q-values: Bergquist and Kjerstadius (2014) estimated a new q-value for the industry group “Software & Electronics”

[10] Avanza, Nasdaq, Yahoo finance and Capital IQ, as well as weighted against each market to obtain the most reasonable beta

of 0.7, an industry that has grown significantly in size since the publication of Runsten’s (1998) original work. Even though the usage of q-values estimated in 2014 on data in the past (e.g. 2002) introduces issues of foreknowledge, q-values should merely be regarded as estimates of the permanent measurement bias; it is assumed that similar values would be obtained should a similar study be performed in 2002. The same assumption applies to q-values estimated by Runsten (1998).

With regards to the remaining q-values which remain unmodified since Runsten’s (1998) original study, we believe that the decrease in permanent measurement bias and resulting inaccuracy of q-values will not have a very strong effect on our results, and either way we are not capable of modifying these values to adjust for the transition to IFRS. Thus, we will continue to use Runsten’s q-values for industries other than the updated Software & Electronics industry category without further modifications.

Table 4: Runsten’s (1998) Permanent Measurement Bias by Industry Calculations

Industry	MES	Building	Trading Property	Land	Investment in Shares	R&D Expenditures	Personnel Development Expenses	Marketing Expenses	Deferred taxes	Total PMB (q-value)
Pharmaceutical	0,06	0,09				1,08			0,51	**1,74**
Capital-intensive service*	0,23	0,15			0,06				0,33	**0,76**
Consumer goods	0,15	0,11			0,01			0,25	0,2	**0,72**
Investment companies					0,53				0,16	**0,68**
Pulp and paper*	0,23	0,08		0,07	0,01				0,27	**0,67**
Shipping	0,47	0,02			0,02				0,14	**0,65**
Other Services	0,03	0,04			0,02		0,4		0,14	**0,62**
Consultants & computer*	0,03				0,01		0,4		0,15	**0,59**
Real estate		0,31	0,12	0,01	0,01				0,1	**0,56**
Mixed building & real estate	0,02	0,02	0,35	0,01	0,01				0,12	**0,55**
Trading & retail	0,03	0,21							0,23	**0,47**
Chemical industry*	0,1	0,12			0,01				0,21	**0,44**
Building & construction	0,03	0,03	0,12	0,01	0,02				0,16	**0,38**
Engineering*	0,07	0,1			0,01				0,15	**0,33**
Other production*	0,07	0,1			0,01				0,13	**0,31**
Conglomerates & mixed investments*	0,04	0,08			0,08				0,09	**0,28**

4.2.6 Bankruptcy prediction in the RIV model

Previous literature argues that a second adjustment is necessary to take into account the statistical probability that the firm will not survive and go bankrupt, which would reduce the value of any future returns and accordingly, the firm’s equity. Skogsvik (1987) developed a multivariate bankruptcy prediction model using key ratios that are based upon accounting numbers which have predictive value. The model was developed using a sample of 386 manufacturing and mining firms in Sweden over the 1973 - 1981 period, of which 328 firms survived while 58 companies failed. However, Skogsvik’s sample is based upon manufacturing and mining firms in Sweden during the 1970s (Skogsvik, 1990), which likely makes the model a poor fit for young startup firms, and furthermore our sample of startups is comprised of firms that operate overwhelmingly in the healthcare and computer technology sectors, and have a radically different financial structure than manufacturing and mining firms that have large amounts of physical assets (e.g. property, plant & equipment).

Finally, the practical limitation of not being able to forecast the probability of failure for our sample firms in each individual year inhibits our ability to incorporate the Skogsvik (1987) model into our study. Other accounting-based bankruptcy prediction models, such as Beaver (1966), Altman (1968), Ohlson (1980), Zmijewski (1984), Shumway (2001), and Hillegeist et al. (2004), also have similar problems with both poor geographical and sample fit, as well as our inability to forecast failure predictions for each firm in each year.

To our knowledge, no bankruptcy prediction model specifically designed for startups exists. However, bankruptcy risk has a material effect on the valuation of a firm, especially so for a startup firm. While we cannot apply a traditional bankruptcy prediction model to our sample, we instead test a range of bankruptcy probabilities ranging from 0% to 10% to still incorporate some kind of correction for the chance that the firms will go bankrupt. The probability of failure can be plugged into the cost of equity capital under the simplifying assumption that it is constant (Skogsvik, 2002). We find support for the upper bound of 10% from Cornell & Damodaran (2014), who use this as an upper bound for the valuation of Tesla, Inc., a firm that does not match the definition of a startup but does match the criteria of a so-called “unicorn” firm and has negative net income, high growth, and a high valuation, which is a set of characteristics that many firms in our sample meet.

The probability of failure can be expressed as:

$$\rho_e^* = \frac{\rho_e + p_{fail}}{(1 - p_{fail})} \tag{9}$$

Where:

ρ_e^* = the cost of equity capital, adjusted for the probability of failure

ρ_e = the unadjusted cost of equity capital

p_{fail} = the probability of failure, as a percentage rate

4.2.7 Growth rate in steady state

Following in the footsteps of Johansson & Lengholt (2017), we acknowledge that many startups will likely continue to have higher-than-average growth beyond the explicitly forecast horizon, and such an acknowledgement would call for the use of a high growth rate in the terminal value calculation. However, since steady state is assumed to be a value forecast into perpetuity, using a high growth rate is a risky assumption, as the firm's growth rate will fall to expected levels at some point within that perpetuity (Johansson & Lengholt, 2017).

To resolve this predicament, we choose to test both a higher (4%) and lower (2%) growth rate in both the Base Case and the additional tests to see how the companies develop under each assumption. The higher growth rate of 4% follows Anesten et al (2020) and Francis et al (2000), while the 2% growth rate is in line with long-term world GDP.

4.3 One sample t-test

To compare the findings of Implied ROE with the industry average ROE, we will use the One Sample t-test, which determines whether the sample mean is statistically different from a known or hypothesized population mean. Considering that following assumptions are met:

1) *The data are continuous (not discrete)*
2) *The data follow the normal probability distribution*
3) *The sample is a simple random sample from its population. Each individual in the population has an equal probability of being selected in the sample*

we can assume the first sample t-test is robust and the best fit for our testing purposes.

Following the most common approach, we have set alpha as 0.05 and the null hypothesis (H_o) and (two tailed) alternative hypothesis (H_1) of the one sample T-test can be expressed as:

$$H_0: \mu = Hyposethized\ value$$

Accepting the hypothesis, i.e. showing there is no significant difference between the implied ROE and the industry average ROE

$$H_1: \mu \neq Hyposethized\ value$$

Not accepting the hypothesis, i.e. showing there is a significant difference between the implied ROE and the industry average ROE.

	Communication services	**Consumer discretionary and consumer staples**	**Energy, Materials and industrials**	**Information technology**	**Information technology**
Hypothesized mean (average ROE two years after IPO)	-6.95%	-6.90%	-1.08%	-15.4%	-11.1%

The hypothesized mean as shown in the table above, is obtained from (Appendix I) while studying the historical ROE of startups. The average ROE at year 2 after IPO date is used as comparable ROE for the reasonable test. The reason for using average of Consumer discretionary and consumer staples as well as Energy, Materials and Industrials is due to low sample sizes.

5. Result

5.1 Base case

The results from the Base Case are presented in table 3. Our primary results from the Base Case scenario using 2% as growth rate in steady state, showing that we can only accept our null hypothesis, H_0, for the Communication Services and Consumer Staples & Discretionary sectors with a p(fail) between 0% to 6% and 0% to 3%, respectively, i.e. there is no significant difference between the implied ROE and the industry average ROE for these two industry groupings, and the profit expectations are indeed reasonable.

On the other hand, the results for the Energy, Industrials & Materials, Healthcare, and Information Technology industry groupings show that we do not accept the null hypothesis, but instead accept the alternative hypothesis, i.e. showing that there is a significant difference between the implied ROE and the industry average ROE, and hence the profit expectations are unreasonable. Similar results can be shown when using 4% as growth rate on steady state, except that with this growth rate, we can accept our null hypothesis, H_0, for the Communication Services and Consumer Staples & Discretionary sectors with a p(fail) between 0% to 5% and

0% to 2%, respectively. These results show that higher growth rates in steady state cause the implied ROE to deviate further away from the historical ROE.

The p-value, however, is heavily influenced by the sample sizes: the larger the sample size, the lower the p-value, and therefore it is important to take the entire result into account rather than drawing conclusions based narrowly upon the p-value. This sensitivity to sample size demonstrates the probability that an observed difference could have occurred merely by random chance if the sample size is not large enough to be representative.

Looking at the Communication Services industry, only two firm deviated significantly from the hypothesized mean. Everysport Media Group AB showed a relatively high implied ROE of 60%, compared to a historical average ROE hypothesized mean of -6.9% for a comparable industry grouping, while MAG Interactive showed a very low implied ROE of -59%.

Similarly, looking at the Consumer Discretionary and Consumer Staples industry grouping, three firms out of a total of twelve deviated significantly from the hypothesized mean, with Net Trading Group showing an implied ROE of 404%. Whilst looking at the industry groups, the vast majority of the firms showed higher implied ROE and a corresponding lower p-value, resulting in not accepting the null hypothesis for this group.

5.2 Additional tests

Similar result can be seen with additional tests. The results however showed lower p-value for each case, indicating a larger significant difference between the implied ROE and the industry average ROE. Surprisingly, using the growth rate based on the US market gave better results than EU or any other markets.

Table 5: Result of the Base Test

S.S growth 2%

	Communication services				Consumer staples & discretionary				Energy, industrials & materials				Health care				Information technology			
	n = 10		H. mean = -6.95%		n = 12		H. mean = -6.90%		n = 20		H. mean = -1.08%		n = 46		H. mean = -15.4%		n = 21		H. mean = -11.1%	
P(fail)	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**
0%	0.0241	0.3020	0.0955	0.3530	0.5845	1.1976	0.3457	0.0853	0.7286	1.1305	0.2528	0.0087	0.7149	1.0847	0.1599	2.15E-06	0.7165	0.8290	0.1809	1.84E-04
1%	0.0474	0.3083	0.0975	0.2612	0.6269	1.2176	0.3515	0.0733	0.7806	1.1767	0.2631	0.0072	0.7687	1.1268	0.1661	1.43E-06	0.7638	0.8522	0.1860	1.36E-04
2%	0.0713	0.3150	0.0996	0.1914	0.6702	1.2380	0.3574	0.0629	0.8342	1.2251	0.2739	0.0061	0.8241	1.1705	0.1726	9.70E-07	0.8126	0.8765	0.1913	1.02E-04
3%	0.0957	0.3224	0.1019	0.1397	0.7146	1.2590	0.3634	0.0541	0.8342	1.2251	0.2739	0.0061	0.8812	1.2158	0.1793	6.74E-07	0.8629	0.9019	0.1968	7.74E-05
4%	0.1207	0.3303	0.1044	0.1020	0.7601	1.2806	0.3697	0.0465	0.9468	1.3286	0.2971	0.0045	0.9400	1.2629	0.1862	4.78E-07	0.9148	0.9285	0.2026	5.95E-05
5%	0.1463	0.3388	0.1071	0.0748	0.8066	1.3027	0.3761	0.0400	1.0060	1.3838	0.3094	0.0039	1.0007	1.3118	0.1934	3.46E-07	0.9684	0.9564	0.2087	4.63E-05
6%	0.1725	0.3479	0.1100	0.0554	0.8543	1.3255	0.3826	0.0344	1.0671	1.4416	0.3223	0.0034	1.0632	1.3624	0.2009	2.55E-07	1.0237	0.9855	0.2150	3.65E-05
7%	0.1994	0.3576	0.1131	0.0414	0.9032	1.3490	0.3894	0.0297	1.1302	1.5018	0.3358	0.0030	1.1276	1.4149	0.2086	1.91E-07	1.0808	1.0159	0.2217	2.91E-05
8%	0.2269	0.3680	0.1164	0.0313	0.9533	1.3731	0.3964	0.0256	1.1955	1.5647	0.3499	0.0027	1.1941	1.4693	0.2166	1.46E-07	1.1397	1.0476	0.2286	2.35E-05
9%	0.2552	0.3790	0.1198	0.0240	1.0047	1.3979	0.4036	0.0222	1.2629	1.6303	0.3645	0.0024	1.2626	1.5257	0.2250	1.13E-07	1.2005	1.0807	0.2358	1.92E-05
10%	0.2841	0.3906	0.1235	0.0187	1.0573	1.4235	0.4109	0.0192	1.3327	1.6987	0.3798	0.0022	1.3332	1.5842	0.2336	8.88E-08	1.2633	1.1153	0.2434	1.59E-05

S.S growth 4%

	Communication services				Consumer staples & discretionary				Energy, industrials & materials				Health care				Information technology			
	n = 10		H. mean = -6.95%		n = 12		H. mean = -6.90%		n = 20		H. mean = -1.08%		n = 46		H. mean = -15.4%		n = 21		H. mean = -11.1%	
P(fail)	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**
0%	0.0370	0.2950	0.0933	0.2832	0.6011	1.1910	0.3438	0.0773	0.7402	1.1262	0.2518	0.0077	0.7287	1.0828	0.1596	1.55E-06	0.7266	0.8267	0.1804	1.57E-04
1%	0.0599	0.3016	0.0954	0.2079	0.6429	1.2111	0.3496	0.0665	0.7917	1.1727	0.2622	0.0064	0.7820	1.1250	0.1659	1.05E-06	0.7736	0.8500	0.1855	1.17E-04
2%	0.0834	0.3087	0.0976	0.1517	0.6858	1.2318	0.3556	0.0573	0.8450	1.2212	0.2731	0.0055	0.8370	1.1688	0.1723	7.32E-07	0.8221	0.8744	0.1908	8.85E-05
3%	0.1075	0.3164	0.1000	0.1107	0.7296	1.2530	0.3617	0.0494	0.9001	1.2720	0.2844	0.0047	0.8936	1.2143	0.1790	5.19E-07	0.8721	0.9000	0.1964	6.78E-05
4%	0.1321	0.3246	0.1026	0.0812	0.7746	1.2748	0.3680	0.0426	0.9570	1.3251	0.2963	0.0041	0.9520	1.2615	0.1860	3.75E-07	0.9238	0.9267	0.2022	5.26E-05
5%	0.1573	0.3334	0.1054	0.0599	0.8207	1.2972	0.3745	0.0368	1.0158	1.3806	0.3087	0.0036	1.0123	1.3104	0.1932	2.76E-07	0.9771	0.9547	0.2083	4.13E-05
6%	0.1832	0.3428	0.1084	0.0447	0.8679	1.3202	0.3811	0.0318	1.0766	1.4384	0.3216	0.0031	1.0744	1.3612	0.2007	2.07E-07	1.0321	0.9839	0.2147	3.28E-05
7%	0.2097	0.3528	0.1116	0.0337	0.9164	1.3438	0.3879	0.0275	1.1394	1.4989	0.3352	0.0028	1.1384	1.4138	0.2085	1.57E-07	1.0889	1.0144	0.2214	2.63E-05
8%	0.2369	0.3634	0.1149	0.0258	0.9660	1.3681	0.3949	0.0238	1.2043	1.5619	0.3492	0.0025	1.2045	1.4683	0.2165	1.22E-07	1.1475	1.0462	0.2283	2.14E-05
9%	0.2648	0.3747	0.1185	0.0200	1.0169	1.3932	0.4022	0.0206	1.2715	1.6276	0.3639	0.0023	1.2726	1.5248	0.2248	9.56E-08	1.2081	1.0795	0.2356	1.76E-05
10%	0.2934	0.3866	0.1223	0.0157	1.0692	1.4189	0.4096	0.0179	1.3410	1.6962	0.3793	0.0021	1.3429	1.5833	0.2334	7.61E-08	1.2706	1.1142	0.2431	1.46E-05

6. Discussion

6.1 Initial Analysis

Conditioned on the assumption that the share prices of our sample firms can be fully described by our fundamental analysis, i.e. the share price is derived from the fundamentals of a firm (i.e. the accounting numbers provided in the financial statements), we can look at the theory behind the RIV formula, break the model down into its components, and conclude that there are other factors that will substantially affect the outcome of our results. Assuming the price is a constant:

1. **Cost of equity affected by probability of failure**

   Considering all else equal in the formula, plugging in a lower probability of failure will return a lower cost of equity, which in turn will reduce the implied ROE value; in other words, the cost of equity will be closer to the implied ROE value. However, even if we plug in a probability of failure rate of 0%, the result shows that we still cannot accept the null hypothesis, demonstrating that there is still a significant difference between the implied ROE and historical industry average ROE despite eliminating the chance that the firm will go bankrupt. Therefore, we will need to explore other factors within the RIV model.

2. **Book value of equity that is determined by the historical growth rate**

   Putting in a higher book value of equity will result in a lower implied ROE considering all else equal, as can be seen by comparing the results using the historical Nordic growth rate, where the growth rate on the book value of equity is higher (above 20% in the first three years) than other historical growth rates. Despite the growth rate of 20%, which according to EUROSTAT and the OECD’s definition is considered as the growth rate of a high growth firm, our result still showed a markedly higher implied ROE compared to the average historical ROE, and thus we must reject the null hypothesis in this scenario. This indicates that there must be other factors at play that have greater explanatory power for our result.

3. **Permanent measurement bias (the q-value)**

   The q-values, or permanent measurement bias coefficients taken from Runsten (1998), undoubtedly have a notable impact on our results by making significant changes to the terminal value figures in the RIV formula. However, we are not equipped with the knowledge and skills necessary to make qualified judgements on these values. Nor is that the point of this thesis, and hence we will not go any further into this subject and assume that q-values are still mostly correct. However, we must note that in the course of our modeling, our sample firms did not always match up with Runsten's categories, and thus some subjective categorizations had to be made. This means that some of the q-values applied to certain firms could have been substituted with other q-values, but we do not believe that the different terminal values would be so different as to have a significant effect on our conclusions (i.e. a rejected null hypothesis becomes an accepted null hypothesis). We urge further research into the relevance and applicability of Runsten's q-values and categories in the 21st century.

Conditioned on the assumption that the average industry historical ROE represents a measure of reasonable expectations, the high implied ROE result indicates that investors seemingly base their investment decisions on something other than what would be considered a reasonable fundamental value. If, following the Efficient Market Hypothesis, supply and demand for securities determines the equilibrium price and that the prices fully and instantaneously reflect all available relevant information - that is, they are informationally efficient - there must be additional information that indicates that the startups in our sample will grow tremendously in the future (i.e. generate a high, abnormal return), given the extreme implied growth of book values of equity implied. This is confirmed by Ou and Penman (1989), Frankel & Lee (1998), and Skogsvik & Skogsvik (2010) in their analyses of stock prices in Sweden, the United States, and the United Kingdom to see if accounting information is fully accounted for. However, the hypothesis has been disputed by a number of anomalies that undermine the idea that prices truly reflect available information:

Small-firm effect - small firms tend to have abnormally high returns due to:

1. January effect: Abnormal price rises every January unexplained by fundamentals
2. Market overreaction to news announcements (and degree of overreaction)
3. Excessive stock price volatility relative to fluctuations in fundamental value
4. Mean reversion (low returns today → higher returns in future, and vice versa)
5. New information is not always immediately incorporated into stock prices

These deviations from the Efficient Market Hypothesis show that while the hypothesis might be a reasonable starting point for understanding stock markets in theory, it is not the whole story. In line with our findings, the small-firm effect seems to be true, as startups are considered small firms and have abnormally high returns, and markets accordingly have higher expectations (through the higher implied ROE), resulting in higher stock prices. The startups in our sample also demonstrate strong mean reversion, which is backed up by Laitinen's (2017) study on Finnish startups and Fama & French's (1992) more general study.

6.2 Behavioral Explanations

If markets are not truly efficient, then explanations for our results can be found within the realm of behavioral finance, which posits that investors can be led astray from fundamental values due to psychological and emotional factors. Some of these psychological factors include, but are not limited to:

1. Overconfidence
2. Overreaction
3. Representative Bias
4. Anchoring
5. Loss-aversion
6. Systemic Behavior

Stemming from this, Kahneman and Tversky (1979) find that investors systematically overrate their own ability to forecast future stock prices and earnings, which would align with the many studies showing consistent overconfidence and overoptimism from investors. Cogliati et al (2010), Mumtaz & Smith (2015), and Gajarova & Qin (2019) agree that investors are too optimistic, but that the fault lies with bullish predictions of growth, rather than prices and earnings. If investors believe that high growth will continue in the future due to past high growth, this would be an example of representative bias at play, as there is no guarantee that future growth will resemble past growth.

Expectations for the startups in our sample could be unrealistic and do not reflect the fundamental value of the firms. This aligns with the conclusions of Cogliati et al (2010), Mumtaz & Smith (2015), and Gajarova & Qin (2019), who theorize that while a high return on equity could be a result of high expectations for future growth and is therefore a valid justification for a high valuation, investors are systematically over-optimistic in their assessments on future growth and profitability. The expected growth and implied returns on equity are so high that it would be exceedingly difficult, if not outright impossible, for most late-stage startup firms to meet them.

6.2.1 High e(ROE) Industry Categories

Some categories of our firms, such as healthcare, information technology, and energy, industrials, and materials, could also be subject to herding behavior and systematic bias, which is key to understanding how economic bubbles form. These categories had implied returns on equity of 71.7%, 71.5%, 72.9% respectively, even when the probability of failure was set to zero, demonstrating extremely high profit returns even in a world without bankruptcy risk. Meanwhile, the historical returns for these industry categories were -15.4%, -11.1%, and -1.08%, respectively.

These industries had the largest gaps between implied and historical ROEs, which piques our curiosity. The energy, industrials, and materials category is dominated by renewable energy and materials firms, and sustainability-oriented companies have attracted strong investment from both inside and outside the Nordics, so it is not entirely surprising to see such high expectations for these firms. Healthcare and information technology companies have also been hot sectors that attract sizable investment, and are often the source of successful outlier firms that attract sensational media coverage and attract further investment and attention to other companies in this sector who benefit from the outliers' success.

6.2.2 Communications Services Grouping

Meanwhile, our sample of communications services companies shows an implied return on equity of just 2% even when the probability of failure was set to zero, compared to the historical ROE of -6.9%, indicating that expectations are in line with historical trends and thus we accept the null hypothesis. Diving into this industry category shows the following firms:

- Fifth Planet Games
- Bamboozer
- Boliga Group
- Bublar Group
- Enad Global Seven
- NextGames Oyj
- Mag Interactive
- Zeta Display
- Every Sport Media Group
- Qiwi Games

This industry category is primarily made up of mobile gaming companies, which historically have high growth and returns that are evenly spread across the entire sector. Because of the consistency of financial performance, it is perhaps unsurprising to see expected returns that are roughly in line with actual historical returns; investors know exactly what they are getting from this sector (Skobeltcyn & Shen, 2018).

6.2.3 Consumers

Consumer discretionary and consumer staples companies, in contrast, are the middle of the bunch, with an implied ROE deviation that is large enough for us to reject the null hypothesis but is not an extreme difference. This is unsurprising, given that these categories are generally quite stable, no matter if they are startups or established firms (S&P DOW Jones Indices, 2019), and it is thus reasonable that the market would expect startups to achieve a solid return once they become a more established firm.

However, returning to the definition of a startup can shed some light upon these high implied returns on equity. One of the key criteria of a startup, alongside low revenue and high innovation, is the potential for high growth. While growth does not always equal value or profit, it does offer investors a chance at reaping a sizable future reward that will compensate for the higher initial risk of investing in a startup.

6.2.4 Future Reversion

Cornell & Damodaran (2014) assert that stock prices can diverge significantly and persistently from rational fundamental value, but will not diverge forever. At some point, as the picture about the firm's ability to generate returns becomes clearer, price and value should start to converge again. As a result, the share prices of our startups should stagnate and then fall at some point in the future when the firm begins to fall short of investors' high expectations.

6.3 – Limitations

6.3.1 - Sample Sizes

However, results are qualified by the low sample size of some of our industry groupings. While the Information Technology (21), Healthcare (46), and Industrials, Materials, Energy (19) groupings had enough companies in each sample to give their results some statistical power, the Consumer (9) and Communication Services (10) groupings had a much smaller number of observations, which undermines their representative power for comparable industry groupings. Hence, while we have confidence in our rejection of the Information Technology, Healthcare, and Industrials, Materials, Energy groupings, we must urge caution with the acceptance of the Communication Services results and rejection of the Consumers grouping results due to small sample sizes. Further research on these two groups with a larger sample size is warranted.

6.3.2 – Model assumptions

The basis of this paper is predicated upon a company's implied vs. actual return on equity. However, return on equity is not always the most reliable financial ratio to rely upon, since it is heavily influenced by the cost of equity capital and Runsten's (1998) q-values. The cost of equity capital influences the return on equity through the Capital Asset Pricing Model (CAPM) model, which has also been the subject of harsh criticism for its unrealistic assumptions (Fama & French, 2003; Dayala, 2012). However, the CAPM is the most widely used model for approximating the cost of equity capital in actual practice, and hence we still find it reasonable to use the CAPM since we are basing our study off of valuations made in actual practice and not trying to come up with a fundamental valuation ourselves.

6.3.3 - Average historical ROE as a measure of reasonableness

A fundamental underpinning of this thesis is the assumption that the historical return on equity is the definition of "reasonable", against which our sample's implied return on equity should be judged as a benchmark. We also assume that every firm in our sample will follow a linear reversion to steady state return on equity. However, it is very unlikely that all 109 firms in our sample will follow the same reversion trend, given that the sample is so diverse and startups are inherently unpredictable.

Furthermore, not all firms in our sample went public at the same point in their life cycle, with some firms going public as little as two years after founding and others waiting for ten years before undertaking an IPO. This has important implications for our historical sample in that different returns on equity can be expected at different stages in their lifecycle. The type of company also adds another layer of complexity to this, as (bio)pharmaceutical firms and other firms that have a large portion of intellectual property in the form of patents that result from R&D expense will have severely negative historical returns on equity that are not reliable bases for future returns due to immediate expensing of R&D expenditures.

6.4 - Implementability and persistence

With regards to previous research, the results from our study are notable in the level of divergence between the implied return on equity derived from actual share prices and the return on equity derived from a fundamental valuation of the companies. However, the question at the conclusion of this academic study is if these methods can be implemented in real-world practice. As described in the Research Design, a very specific group of startups were chosen, the primary criteria that made this study possible is that the startups are publicly listed firms. Since the vast majority of startup firms either fail before going public or are purchased by another company, our sample is not fully representative of all startup firms and survivorship bias plays a role in this study.

7. Concluding remarks

We find further statistical support for the notion that mispricing continues to be an issue in the stock markets and can in part be derived from unreasonable profit expectations from investors. For startups, the difference between the implied ROE for a sample of publicly traded Nordic firms and a realized ROE from a historical control sample is extreme and indicative of mispricing, which aligns with previous studies empirically demonstrating that actual market prices diverge sharply from what fundamentals would suggest. The results validate Hypothesis I in only a handful of specific situations, usually when growth is high and the p(fail) is low; however, small sample sizes complicate the results from some of the industry groupings, and company-by-company analysis reveals divergent results within the groupings.

The source of this mispricing appears to be extremely bullish predictions for growth, which makes sense seeing as a fundamental trait of a startup is the potential for growth. While high growth expectations can justify a high valuation, our results appear to indicate that oftentimes, expectations are so high that they would be nearly impossible for the firm to meet them. The results further confirm Cogliati et al’s (2010) assertion that investors are systematically overconfident, leading to mispricing. This weakens the efficient market hypothesis, and warrants further research looking to behavioral finance theories for further explanation.

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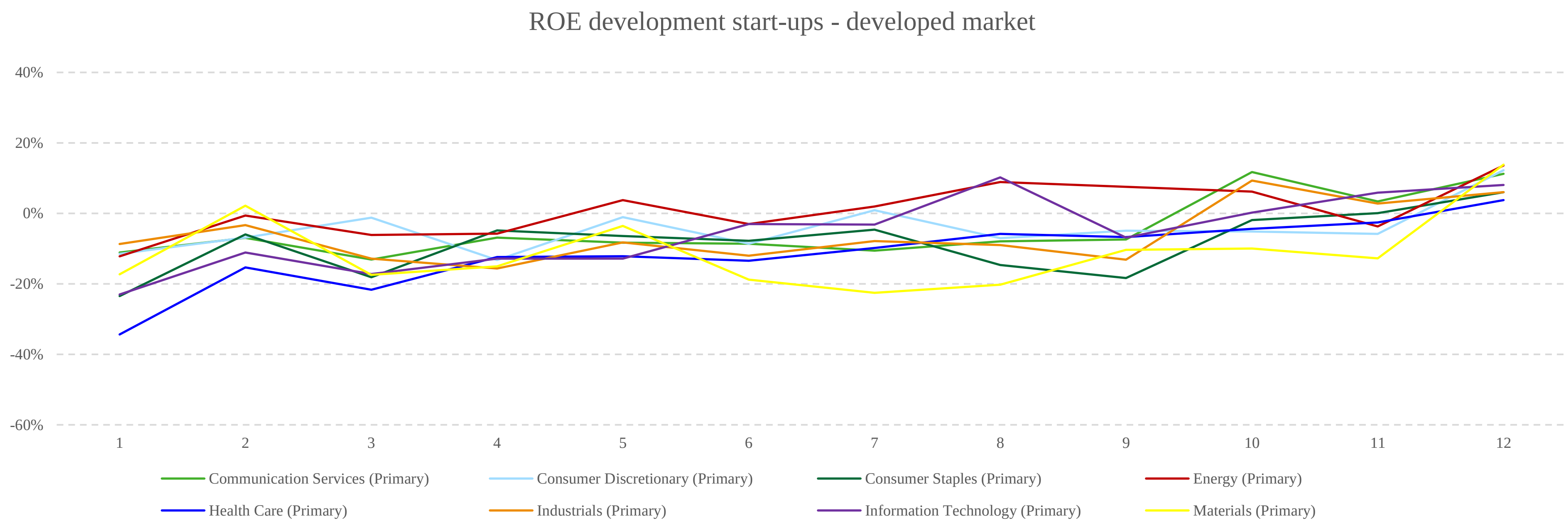
Appendix I



	1		2		3		4		5		6		7		8		9		10		11		12	
	Average	**S.D**	**Average**	**S.D**	**Average**	**S.D**	**Average**	**S.D**	**Average**	**S.D**	**Average**	**S.D**	**Average**	**S.D**	**Average**	**S.D**	**Average**	**S.D**	**Average**	**S.D**	**Average**	**S.D**	**Average**	**S.D**
Communication Services	-11%	0.4909	-6.9%	0.4825	-13.1%	0.5191	-6.9%	0.3014	-8.3%	0.4333	-8.6%	0.48138	-10.5%	0.3309	-7.9%	0.2783	-7.4%	0.4078	11.7%	0.5036	3.4%	0.1829	11.2%	0.2354
Consumer Discretionary	-11%	0.4485	-6.9%	0.4946	-1.2%	0.2852	-13.2%	0.6335	-1.1%	0.2858	-8.6%	0.44397	0.9%	0.3407	-7.0%	0.3662	-4.9%	0.3820	-5.1%	0.3416	-5.9%	0.3349	12.2%	0.1808
Consumer Staples	-23%	0.5920	-6.0%	0.6897	-18.1%	0.5037	-4.8%	0.4117	-6.4%	0.4986	-7.8%	0.46617	-4.6%	0.3413	-14.6%	0.4944	-18.3%	0.4669	-1.9%	0.1355	0.1%	0.1655	6.0%	0.3795
Energy	-12%	0.4569	-0.6%	-0.0061	-6.2%	0.3286	-5.7%	0.4580	3.7%	0.4663	-3.0%	0.38722	1.9%	0.5419	8.9%	0.2429	7.6%	0.2635	6.1%	0.2436	-3.7%	0.3423	13.6%	0.2101
Health Care	-34%	0.4720	-15.4%	0.4493	-21.7%	0.6151	-12.4%	0.4128	-12.2%	0.4201	-13.4%	0.34863	-9.8%	0.3344	-5.8%	0.4063	-6.7%	0.3916	-4.4%	0.3135	-2.6%	0.2723	3.8%	0.1267
Industrials	-9%	0.4178	-3.3%	0.2218	-12.8%	0.5562	-15.6%	0.7300	-8.2%	0.3867	-12.0%	0.46488	-7.9%	0.2511	-9.0%	0.2923	-13.1%	0.5058	9.3%	0.1638	2.8%	0.2816	6.0%	0.0980
Information Technology	-23%	0.5257	-11.1%	0.4205	-17.2%	0.5638	-12.8%	0.4599	-12.8%	0.4217	-3.1%	0.45111	-3.1%	0.4237	10.2%	0.2295	-6.9%	0.4924	0.3%	0.3332	5.9%	0.2888	8.1%	0.1824
Materials	-17%	0.5443	2.2%	0.2448	-17.4%	0.3443	-15.0%	0.4431	-3.6%	0.3925	-18.8%	0.41723	-22.5%	0.4354	-20.2%	0.4388	-10.4%	0.3604	-10.0%	0.2745	-12.8%	0.4932	13.8%	0.0000

	1		2		3		4		5		6		7		8		9		10		11		12	
	Growth	**n**	**Growth**	**n**	**Growth**	**n**	**Growth**	**n**	**Growth**	**n**	**Growth**	**n**	**Growth**	**n**	**Growth**	**n**	**Growth**	**n**	**Growth**	**n**	**Growth**	**n**		**n**
Communication Services	-37.49%	54	88.55%	36	-47.64%	49	21.27%	39	3.30%	37	22.70%	35	-24.81%	23	-6.71%	22	-258.69%	21	-71.25%	20	233.44%	18	-	16
Consumer Discretionary	-149.42%	80	-121.68%	37	974.33%	67	-92.06%	55	718.63%	48	-110.74%	39	-860.67%	30	-30.00%	32	4.42%	27	13.99%	23	-309.15%	21	-	18
Consumer Staples	-74.41%	23	201.66%	13	-73.27%	18	32.45%	14	21.85%	14	-40.92%	14	217.30%	9	25.04%	9	-89.60%	9	-104.39%	5	7087.93%	3	-	4
Energy	-94.99%	97	906.82%	64	-7.04%	86	-165.20%	60	-180.75%	52	-164.12%	46	358.79%	37	-14.72%	33	-18.66%	29	-159.87%	23	-469.49%	20	-	15
Health Care	-55.31%	88	41.06%	58	-42.90%	64	-1.63%	45	10.38%	45	-26.99%	35	-40.61%	24	15.36%	25	-34.72%	19	-41.02%	17	-245.80%	16	-	14
Industrials	-61.94%	68	287.08%	43	22.02%	60	-47.56%	46	46.50%	34	-34.58%	29	14.80%	21	45.51%	20	-170.97%	19	-69.99%	14	115.05%	11	-	10
Information Technology	-51.82%	113	55.53%	77	-25.72%	97	-0.05%	84	-76.08%	77	2.57%	63	-425.39%	54	-167.63%	51	-103.67%	54	2207.61%	48	38.25%	45	-	35
Materials	-112.63%	36	-900.27%	19	-13.89%	32	-76.14%	23	425.45%	14	19.70%	15	-10.31%	10	-48.75%	9	-3.85%	8	28.27%	6	-208.29%	4	-	1

Appendix II

Additional Test I: Using All historical growth rate

S.S growth 2%

	Communication services				Consumer staples & discretionary				Energy, industrials & materials				Health care				Information technology			
	n = 10		H. mean = -6.95%		n = 12		H. mean = -6.90%		n = 20		H. mean = -1.08%		n = 46		H. mean = -15.4%		n = 21		H. mean = -11.1%	
P(fail)	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**
0%	0.1264	0.3070	0.0971	0.0745	0.7663	1.2240	0.3533	0.0375	0.9463	1.3173	0.2946	0.0042	0.9468	1.2528	0.1847	3.59E-07	0.9051	0.9085	0.1983	5.16E-05
1%	0.1488	0.3163	0.1000	0.0570	0.8079	1.2453	0.3595	0.0329	1.0006	1.3705	0.3065	0.0038	1.0021	1.2992	0.1915	2.76E-07	0.9543	0.9354	0.2041	4.16E-05
2%	0.1719	0.3262	0.1031	0.0440	0.8506	1.2671	0.3658	0.0288	1.0568	1.4258	0.3188	0.0034	1.0592	1.3471	0.1986	2.16E-07	1.0051	0.9633	0.2102	3.39E-05
3%	0.1956	0.3365	0.1064	0.0344	0.8943	1.2895	0.3723	0.0252	1.1148	1.4833	0.3317	0.0030	1.1180	1.3967	0.2059	1.70E-07	1.0574	0.9924	0.2166	2.79E-05
4%	0.2199	0.3473	0.1098	0.0272	0.9391	1.3125	0.3789	0.0222	1.1747	1.5431	0.3451	0.0028	1.1787	1.4479	0.2135	1.36E-07	1.1114	1.0226	0.2231	2.31E-05
5%	0.2448	0.3586	0.1134	0.0217	0.9852	1.3361	0.3857	0.0195	1.2366	1.6053	0.3590	0.0025	1.2412	1.5008	0.2213	1.10E-07	1.1671	1.0540	0.2300	1.94E-05
6%	0.2704	0.3704	0.1171	0.0176	1.0324	1.3604	0.3927	0.0171	1.3005	1.6700	0.3734	0.0023	1.3056	1.5555	0.2293	8.99E-08	1.2245	1.0867	0.2371	1.64E-05
7%	0.2967	0.3828	0.1211	0.0144	1.0808	1.3853	0.3999	0.0151	1.3666	1.7371	0.3884	0.0022	1.3719	1.6120	0.2377	7.41E-08	1.2837	1.1207	0.2445	1.40E-05
8%	0.3237	0.3957	0.1251	0.0119	1.1305	1.4109	0.4073	0.0133	1.4348	1.8069	0.4040	0.0020	1.4404	1.6704	0.2463	6.17E-08	1.3448	1.1559	0.2522	1.20E-05
9%	0.3515	0.4092	0.1294	0.0100	1.1815	1.4372	0.4149	0.0118	1.5053	1.8794	0.4202	0.0019	1.5109	1.7306	0.2552	5.18E-08	1.4078	1.1925	0.2602	1.04E-05
10%	0.3800	0.4233	0.1339	0.0084	1.2339	1.4643	0.4227	0.0104	1.5781	1.9547	0.4371	0.0018	1.5835	1.7928	0.2643	4.39E-08	1.4728	1.2306	0.2685	9.07E-06

S.S growth 4%

	Communication services				Consumer staples & discretionary				Energy, industrials & materials				Health care				Information technology			
	n = 10		H. mean = -6.95%		n = 12		H. mean = -6.90%		n = 20		H. mean = -1.08%		n = 46		H. mean = -15.4%		n = 21		H. mean = -11.1%	
P(fail)	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**
0%	0.1375	0.3021	0.0955	0.0584	0.7806	1.2186	0.3518	0.0343	0.9562	1.3142	0.2939	0.0038	0.9585	1.2516	0.1845	2.83E-07	0.9139	0.9070	0.1979	4.57E-05
1%	0.1597	0.3116	0.0986	0.0451	0.8217	1.2400	0.3580	0.0301	1.0102	1.3675	0.3058	0.0034	1.0135	1.2981	0.1914	2.22E-07	0.9628	0.9339	0.2038	3.72E-05
2%	0.1824	0.3217	0.1017	0.0353	0.8639	1.2621	0.3643	0.0265	1.0661	1.4229	0.3182	0.0031	1.0702	1.3461	0.1985	1.76E-07	1.0133	0.9619	0.2099	3.05E-05
3%	0.2057	0.3322	0.1051	0.0279	0.9072	1.2846	0.3708	0.0233	1.1238	1.4806	0.3311	0.0028	1.1286	1.3957	0.2058	1.41E-07	1.0653	0.9911	0.2163	2.53E-05
4%	0.2297	0.3433	0.1085	0.0223	0.9516	1.3078	0.3775	0.0205	1.1834	1.5405	0.3445	0.0026	1.1889	1.4470	0.2134	1.14E-07	1.1191	1.0214	0.2229	2.11E-05
5%	0.2543	0.3548	0.1122	0.0180	0.9972	1.3316	0.3844	0.0181	1.2450	1.6029	0.3584	0.0024	1.2510	1.5000	0.2212	9.34E-08	1.1745	1.0529	0.2298	1.78E-05
6%	0.2796	0.3668	0.1160	0.0147	1.0440	1.3560	0.3914	0.0160	1.3086	1.6676	0.3729	0.0022	1.3151	1.5548	0.2292	7.72E-08	1.2317	1.0857	0.2369	1.51E-05
7%	0.3056	0.3794	0.1200	0.0122	1.0921	1.3810	0.3987	0.0141	1.3744	1.7349	0.3879	0.0020	1.3811	1.6113	0.2376	6.43E-08	1.2907	1.1197	0.2443	1.30E-05
8%	0.3323	0.3925	0.1241	0.0102	1.1414	1.4068	0.4061	0.0125	1.4424	1.8048	0.4036	0.0019	1.4492	1.6697	0.2462	5.41E-08	1.3515	1.1550	0.2521	1.12E-05
9%	0.3598	0.4062	0.1284	0.0086	1.1920	1.4333	0.4138	0.0111	1.5126	1.8774	0.4198	0.0018	1.5194	1.7300	0.2551	4.59E-08	1.4143	1.1917	0.2601	9.75E-06
10%	0.3880	0.4204	0.1329	0.0074	1.2440	1.4605	0.4216	0.0099	1.5851	1.9528	0.4367	0.0017	1.5917	1.7923	0.2643	3.92E-08	1.4790	1.2298	0.2684	8.55E-06

Appendix III

Additional test II: Using EU & Nordics historical growth rate

S.S growth 2%

	Communication services				Consumer staples & discretionary				Energy, industrials & materials				Health care				Information technology			
	n = 10		H. mean = -6.95%		n = 12		H. mean = -6.90%		n = 20		H. mean = -1.08%		n = 46		H. mean = -15.4%		n = 21		H. mean = -11.1%	
P(fail)	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**
0%	0.1459	0.3176	0.1004	0.0606	0.8077	1.2377	0.3573	0.0320	1.0051	1.3829	0.3092	0.0039	1.0079	1.3086	0.1929	2.90E-07	0.9556	0.9360	0.2043	4.14E-05
1%	0.1687	0.3272	0.1035	0.0469	0.8498	1.2590	0.3634	0.0281	1.0605	1.4374	0.3214	0.0035	1.0641	1.3557	0.1999	2.26E-07	1.0056	0.9636	0.2103	3.38E-05
2%	0.1921	0.3373	0.1067	0.0366	0.8928	1.2808	0.3697	0.0246	1.1176	1.4940	0.3341	0.0032	1.1220	1.4043	0.2071	1.79E-07	1.0571	0.9922	0.2165	2.79E-05
3%	0.2162	0.3479	0.1100	0.0289	0.9369	1.3032	0.3762	0.0216	1.1766	1.5528	0.3472	0.0029	1.1816	1.4545	0.2145	1.43E-07	1.1102	1.0219	0.2230	2.32E-05
4%	0.2408	0.3590	0.1135	0.0231	0.9822	1.3262	0.3829	0.0190	1.2374	1.6138	0.3609	0.0026	1.2430	1.5064	0.2221	1.16E-07	1.1649	1.0528	0.2297	1.95E-05
5%	0.2660	0.3705	0.1172	0.0187	1.0285	1.3499	0.3897	0.0168	1.3001	1.6773	0.3750	0.0024	1.3061	1.5599	0.2300	9.47E-08	1.2213	1.0849	0.2368	1.65E-05
6%	0.2919	0.3826	0.1210	0.0153	1.0760	1.3742	0.3967	0.0148	1.3649	1.7431	0.3898	0.0022	1.3712	1.6152	0.2381	7.82E-08	1.2794	1.1182	0.2440	1.41E-05
7%	0.3185	0.3953	0.1250	0.0126	1.1247	1.3992	0.4039	0.0131	1.4318	1.8114	0.4050	0.0021	1.4382	1.6722	0.2466	6.51E-08	1.3392	1.1528	0.2516	1.22E-05
8%	0.3458	0.4084	0.1292	0.0106	1.1747	1.4248	0.4113	0.0116	1.5008	1.8824	0.4209	0.0019	1.5072	1.7311	0.2552	5.47E-08	1.4009	1.1887	0.2594	1.06E-05
9%	0.3738	0.4222	0.1335	0.0089	1.2259	1.4513	0.4189	0.0103	1.5720	1.9560	0.4374	0.0018	1.5782	1.7918	0.2642	4.64E-08	1.4644	1.2259	0.2675	9.24E-06
10%	0.4026	0.4365	0.1380	0.0076	1.2785	1.4785	0.4268	0.0091	1.6456	2.0323	0.4544	0.0017	1.6514	1.8545	0.2734	3.96E-08	1.5299	1.2645	0.2759	8.14E-06

S.S growth 4%

	Communication services				Consumer staples & discretionary				Energy, industrials & materials				Health care				Information technology			
	n = 10		H. mean = -6.95%		n = 12		H. mean = -6.90%		n = 20		H. mean = -1.08%		n = 46		H. mean = -15.4%		n = 21		H. mean = -11.1%	
P(fail)	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**
0%	0.1564	0.3131	0.0990	0.0485	0.8211	1.2326	0.3558	0.0294	1.0144	1.3800	0.3086	0.0036	1.0188	1.3075	0.1928	2.35E-07	0.9638	0.9347	0.2040	3.71E-05
1%	0.1789	0.3230	0.1021	0.0379	0.8627	1.2541	0.3620	0.0259	1.0695	1.4346	0.3208	0.0032	1.0747	1.3547	0.1997	1.86E-07	0.9638	0.9347	0.2040	3.71E-05
2%	0.2020	0.3333	0.1054	0.0299	0.9053	1.2761	0.3684	0.0228	1.1263	1.4914	0.3335	0.0029	1.1322	1.4034	0.2069	1.49E-07	1.0648	0.9910	0.2163	2.54E-05
3%	0.2257	0.3440	0.1088	0.0239	0.9490	1.2986	0.3749	0.0201	1.1850	1.5503	0.3467	0.0027	1.1915	1.4537	0.2143	1.21E-07	1.1177	1.0208	0.2228	2.13E-05
4%	0.2500	0.3553	0.1124	0.0193	0.9939	1.3218	0.3816	0.0177	1.2455	1.6115	0.3603	0.0025	1.2525	1.5056	0.2220	9.89E-08	1.1721	1.0518	0.2295	1.80E-05
5%	0.2750	0.3671	0.1161	0.0158	1.0398	1.3456	0.3884	0.0157	1.3080	1.6750	0.3745	0.0023	1.3154	1.5592	0.2299	8.18E-08	1.2283	1.0840	0.2365	1.53E-05
6%	0.3006	0.3794	0.1200	0.0130	1.0869	1.3701	0.3955	0.0139	1.3725	1.7409	0.3893	0.0021	1.3801	1.6145	0.2380	6.82E-08	1.2861	1.1174	0.2438	1.32E-05
7%	0.3269	0.3922	0.1240	0.0109	1.1353	1.3952	0.4028	0.0123	1.4391	1.8094	0.4046	0.0020	1.4468	1.6716	0.2465	5.74E-08	1.3457	1.1520	0.2514	1.14E-05
8%	0.3539	0.4055	0.1282	0.0092	1.1849	1.4210	0.4102	0.0109	1.5079	1.8804	0.4205	0.0019	1.5154	1.7305	0.2551	4.87E-08	1.4072	1.1879	0.2592	9.94E-06
9%	0.3816	0.4194	0.1326	0.0079	1.2357	1.4476	0.4179	0.0097	1.5789	1.9541	0.4370	0.0018	1.5862	1.7913	0.2641	4.16E-08	1.4705	1.2252	0.2674	8.73E-06
10%	0.4101	0.4338	0.1372	0.0068	1.2880	1.4749	0.4258	0.0087	1.6522	2.0306	0.4540	0.0017	1.6591	1.8540	0.2734	3.58E-08	1.5358	1.2638	0.2758	7.72E-06

Appendix IV

Additional test III: Using Europe historical growth rate

S.S growth 2%

	Communication services				Consumer staples & discretionary				Energy, industrials & materials				Health care				Information technology			
	n = 10		H. mean = -6.95%		n = 12		H. mean = -6.90%		n = 20		H. mean = -1.08%		n = 46		H. mean = -15.4%		n = 21		H. mean = -11.1%	
P(fail)	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**
0%	0.1711	0.3306	0.1046	0.0469	0.8597	1.2546	0.3622	0.0263	1.0800	1.4664	0.3279	0.0035	1.0848	1.3784	0.2032	2.25E-07	1.0197	0.9728	0.2123	3.26E-05
1%	0.1943	0.3407	0.1078	0.0369	0.9022	1.2761	0.3684	0.0231	1.1367	1.5228	0.3405	0.0032	1.1421	1.4267	0.2103	1.80E-07	1.0708	1.0013	0.2185	2.71E-05
2%	0.2180	0.3513	0.1111	0.0293	0.9457	1.2981	0.3747	0.0204	1.1951	1.5814	0.3536	0.0029	1.2011	1.4764	0.2177	1.45E-07	1.1233	1.0310	0.2250	2.27E-05
3%	0.2424	0.3624	0.1146	0.0236	0.9902	1.3207	0.3813	0.0180	1.2553	1.6422	0.3672	0.0027	1.2617	1.5277	0.2253	1.18E-07	1.1775	1.0617	0.2317	1.92E-05
4%	0.2673	0.3739	0.1182	0.0192	1.0359	1.3440	0.3880	0.0159	1.3174	1.7052	0.3813	0.0025	1.3241	1.5807	0.2331	9.67E-08	1.2332	1.0936	0.2386	1.64E-05
5%	0.2928	0.3860	0.1221	0.0158	1.0826	1.3678	0.3949	0.0140	1.3815	1.7706	0.3959	0.0023	1.3883	1.6352	0.2411	8.02E-08	1.2905	1.1267	0.2459	1.41E-05
6%	0.3190	0.3986	0.1260	0.0131	1.1305	1.3924	0.4019	0.0124	1.4475	1.8384	0.4111	0.0021	1.4544	1.6915	0.2494	6.71E-08	1.3495	1.1609	0.2533	1.22E-05
7%	0.3459	0.4116	0.1302	0.0110	1.1796	1.4176	0.4092	0.0110	1.5157	1.9086	0.4268	0.0020	1.5223	1.7496	0.2580	5.67E-08	1.4103	1.1965	0.2611	1.06E-05
8%	0.3734	0.4253	0.1345	0.0093	1.2299	1.4436	0.4167	0.0098	1.5859	1.9815	0.4431	0.0019	1.5923	1.8094	0.2668	4.82E-08	1.4729	1.2333	0.2691	9.32E-06
9%	0.4017	0.4394	0.1390	0.0080	1.2815	1.4703	0.4244	0.0087	1.6584	2.0570	0.4600	0.0018	1.6642	1.8711	0.2759	4.13E-08	1.5374	1.2714	0.2774	8.24E-06
10%	0.4307	0.4542	0.1436	0.0069	1.3343	1.4978	0.4324	0.0078	1.7332	2.1353	0.4775	0.0017	1.7383	1.9347	0.2853	3.57E-08	1.6037	1.3109	0.2861	7.33E-06

S.S growth 4%

	Communication services				Consumer staples & discretionary				Energy, industrials & materials				Health care				Information technology			
	n = 10		H. mean = -6.95%		n = 12		H. mean = -6.90%		n = 20		H. mean = -1.08%		n = 46		H. mean = -15.4%		n = 21		H. mean = -11.1%	
P(fail)	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**
0%	0.1811	0.3266	0.1033	0.0382	0.8723	1.2498	0.3608	0.0243	1.0888	1.4638	0.3273	0.0033	1.0951	1.3775	0.2031	1.87E-07	1.0275	0.9716	0.2120	2.96E-05
1%	0.2039	0.3369	0.1065	0.0304	0.9144	1.2715	0.3670	0.0214	1.1452	1.5203	0.3400	0.0030	1.1521	1.4258	0.2102	1.51E-07	1.0783	1.0002	0.2183	2.47E-05
2%	0.2273	0.3477	0.1099	0.0244	0.9575	1.2937	0.3734	0.0189	1.2033	1.5790	0.3531	0.0028	1.2107	1.4756	0.2176	1.23E-07	1.1306	1.0299	0.2247	2.08E-05
3%	0.2513	0.3589	0.1135	0.0198	1.0016	1.3164	0.3800	0.0167	1.2633	1.6399	0.3667	0.0025	1.2710	1.5270	0.2251	1.01E-07	1.1845	1.0607	0.2315	1.77E-05
4%	0.2760	0.3707	0.1172	0.0163	1.0469	1.3398	0.3868	0.0148	1.3251	1.7030	0.3808	0.0024	1.3331	1.5800	0.2330	8.40E-08	1.2399	1.0927	0.2384	1.52E-05
5%	0.3012	0.3829	0.1211	0.0135	1.0933	1.3639	0.3937	0.0132	1.3889	1.7685	0.3955	0.0022	1.3970	1.6346	0.2410	7.04E-08	1.2971	1.1258	0.2457	1.31E-05
6%	0.3271	0.3956	0.1251	0.0114	1.1408	1.3885	0.4008	0.0117	1.4547	1.8364	0.4106	0.0020	1.4627	1.6910	0.2493	5.95E-08	1.3559	1.1602	0.2532	1.14E-05
7%	0.3537	0.4088	0.1293	0.0096	1.1895	1.4139	0.4082	0.0104	1.5226	1.9068	0.4264	0.0019	1.5304	1.7491	0.2579	5.06E-08	1.4164	1.1958	0.2609	1.00E-05
8%	0.3810	0.4226	0.1336	0.0082	1.2395	1.4400	0.4157	0.0093	1.5926	1.9797	0.4427	0.0018	1.6000	1.8089	0.2667	4.34E-08	1.4788	1.2326	0.2690	8.82E-06
9%	0.4090	0.4369	0.1382	0.0071	1.2907	1.4668	0.4234	0.0083	1.6648	2.0553	0.4596	0.0017	1.6717	1.8707	0.2758	3.75E-08	1.5431	1.2708	0.2773	7.83E-06
10%	0.4378	0.4518	0.1429	0.0062	1.3432	1.4944	0.4314	0.0074	1.7394	2.1337	0.4771	0.0016	1.7455	1.9343	0.2852	3.26E-08	1.6092	1.3103	0.2859	6.99E-06

Appendix V

Additional test IV: Using U.S. historical growth rate

S.S growth 2%

	Communication services				**Consumer staples & discretionary**				**Energy, industrials & materials**				**Health care**				**Information technology**			
	n = 10		H. mean = -6.95%		n = 12		H. mean = -6.90%		n = 20		H. mean = -1.08%		n = 46		H. mean = -15.4%		n = 21		H. mean = -11.1%	
P(fail)	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**
0%	0.1122	0.2960	0.0936	0.0842	0.7328	1.2098	0.3492	0.0423	0.8961	1.2579	0.2813	0.0045	0.8949	1.2021	0.1772	4.13E-07	0.8622	0.8836	0.1928	6.16E-05
1%	0.1341	0.3052	0.0965	0.0642	0.7737	1.2312	0.3554	0.0371	0.9493	1.3098	0.2929	0.0040	0.9492	1.2478	0.1840	3.16E-07	0.9105	0.9097	0.1985	4.92E-05
2%	0.1566	0.3148	0.0996	0.0493	0.8157	1.2531	0.3617	0.0325	1.0043	1.3639	0.3050	0.0035	1.0053	1.2950	0.1909	2.45E-07	0.9603	0.9370	0.2045	3.97E-05
3%	0.1798	0.3250	0.1028	0.0383	0.8588	1.2756	0.3682	0.0285	1.0612	1.4202	0.3176	0.0032	1.0631	1.3439	0.1981	1.92E-07	1.0117	0.9654	0.2107	3.24E-05
4%	0.2036	0.3356	0.1061	0.0300	0.9030	1.2986	0.3749	0.0250	1.1201	1.4787	0.3307	0.0029	1.1227	1.3945	0.2056	1.52E-07	1.0648	0.9950	0.2171	2.67E-05
5%	0.2281	0.3467	0.1096	0.0239	0.9485	1.3222	0.3817	0.0220	1.1809	1.5397	0.3443	0.0026	1.1843	1.4467	0.2133	1.22E-07	1.1196	1.0258	0.2238	2.21E-05
6%	0.2532	0.3584	0.1133	0.0192	0.9952	1.3465	0.3887	0.0193	1.2438	1.6031	0.3585	0.0024	1.2478	1.5008	0.2213	9.92E-08	1.1762	1.0578	0.2308	1.85E-05
7%	0.2791	0.3706	0.1172	0.0156	1.0431	1.3714	0.3959	0.0170	1.3088	1.6691	0.3732	0.0022	1.3134	1.5567	0.2295	8.13E-08	1.2347	1.0912	0.2381	1.57E-05
8%	0.3057	0.3833	0.1212	0.0128	1.0923	1.3970	0.4033	0.0150	1.3761	1.7377	0.3886	0.0020	1.3810	1.6144	0.2380	6.73E-08	1.2950	1.1258	0.2457	1.34E-05
9%	0.3331	0.3966	0.1254	0.0107	1.1429	1.4233	0.4109	0.0132	1.4457	1.8090	0.4045	0.0019	1.4507	1.6741	0.2468	5.62E-08	1.3573	1.1618	0.2535	1.15E-05
10%	0.3613	0.4105	0.1298	0.0090	1.1949	1.4504	0.4187	0.0117	1.5176	1.8832	0.4211	0.0018	1.5227	1.7358	0.2559	4.73E-08	1.4215	1.1993	0.2617	9.95E-06

S.S growth 4%

	Communication services				**Consumer staples & discretionary**				**Energy, industrials & materials**				**Health care**				**Information technology**			
	n = 10		H. mean = -6.95%		n = 12		H. mean = -6.90%		n = 20		H. mean = -1.08%		n = 46		H. mean = -15.4%		n = 21		H. mean = -11.1%	
P(fail)	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**
0%	0.1239	0.2907	0.0919	0.0648	0.7478	1.2041	0.3476	0.0385	0.9065	1.2545	0.2805	0.0040	0.9073	1.2008	0.1770	3.18E-07	0.8714	0.8819	0.1924	5.40E-05
1%	0.1455	0.3001	0.0949	0.0498	0.7882	1.2256	0.3538	0.0338	0.9594	1.3066	0.2922	0.0036	0.9612	1.2466	0.1838	2.48E-07	0.9194	0.9081	0.1982	4.35E-05
2%	0.1676	0.3100	0.0980	0.0387	0.8297	1.2478	0.3602	0.0298	1.0141	1.3608	0.3043	0.0032	1.0168	1.2939	0.1908	1.95E-07	0.9689	0.9355	0.2041	3.54E-05
3%	0.1904	0.3204	0.1013	0.0304	0.8724	1.2704	0.3667	0.0262	1.0707	1.4172	0.3169	0.0029	1.0743	1.3428	0.1980	1.56E-07	1.0201	0.9640	0.2104	2.91E-05
4%	0.2139	0.3313	0.1048	0.0242	0.9162	1.2936	0.3734	0.0231	1.1292	1.4760	0.3300	0.0027	1.1335	1.3935	0.2055	1.25E-07	1.0729	0.9937	0.2168	2.41E-05
5%	0.2381	0.3426	0.1083	0.0195	0.9612	1.3174	0.3803	0.0203	1.1898	1.5370	0.3437	0.0024	1.1947	1.4458	0.2132	1.02E-07	1.1274	1.0246	0.2236	2.02E-05
6%	0.2629	0.3545	0.1121	0.0158	1.0074	1.3418	0.3874	0.0179	1.2524	1.6006	0.3579	0.0022	1.2579	1.5000	0.2212	8.39E-08	1.1838	1.0567	0.2306	1.70E-05
7%	0.2885	0.3669	0.1160	0.0130	1.0550	1.3669	0.3946	0.0158	1.3171	1.6667	0.3727	0.0021	1.3231	1.5559	0.2294	6.96E-08	1.2420	1.0901	0.2379	1.45E-05
8%	0.3148	0.3798	0.1201	0.0109	1.1038	1.3927	0.4020	0.0140	1.3841	1.7354	0.3880	0.0019	1.3903	1.6137	0.2379	5.82E-08	1.3020	1.1248	0.2455	1.24E-05
9%	0.3418	0.3933	0.1244	0.0091	1.1540	1.4191	0.4097	0.0124	1.4534	1.8068	0.4040	0.0018	1.4597	1.6735	0.2467	4.91E-08	1.3641	1.1609	0.2533	1.07E-05
10%	0.3697	0.4074	0.1288	0.0078	1.2056	1.4463	0.4175	0.0110	1.5250	1.8811	0.4206	0.0017	1.5314	1.7352	0.2558	4.18E-08	1.4281	1.1984	0.2615	9.33E-06

Appendix VI

Additional test V: Using Constant 5% growth rate

S.S growth 2%

	Communication services				Consumer staples & discretionary				Energy, industrials & materials				Health care				Information technology			
	n = 10		H. mean = -6.95%		n = 12		H. mean = -6.90%		n = 20		H. mean = -1.08%		n = 46		H. mean = -15.4%		n = 21		H. mean = -11.1%	
P(fail)	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**
0%	0.1430	0.3215	0.1017	0.0662	0.8062	1.2424	0.3587	0.0328	1.0086	1.3936	0.3116	0.0040	1.0104	1.3166	0.1941	3.14E-07	0.9582	0.9414	0.2054	4.30E-05
1%	0.1661	0.3311	0.1047	0.0510	0.8487	1.2637	0.3648	0.0287	1.0644	1.4485	0.3239	0.0036	1.0672	1.3640	0.2011	2.44E-07	1.0087	0.9691	0.2115	3.51E-05
2%	0.1898	0.3411	0.1079	0.0397	0.8922	1.2855	0.3711	0.0251	1.1221	1.5055	0.3366	0.0033	1.1256	1.4130	0.2083	1.92E-07	1.0606	0.9979	0.2178	2.89E-05
3%	0.2140	0.3517	0.1112	0.0313	0.9367	1.3079	0.3776	0.0220	1.1816	1.5647	0.3499	0.0030	1.1858	1.4635	0.2158	1.53E-07	1.1142	1.0279	0.2243	2.40E-05
4%	0.2389	0.3628	0.1147	0.0249	0.9823	1.3309	0.3842	0.0194	1.2429	1.6262	0.3636	0.0027	1.2477	1.5157	0.2235	1.23E-07	1.1693	1.0589	0.2311	2.01E-05
5%	0.2644	0.3744	0.1184	0.0200	1.0291	1.3545	0.3910	0.0170	1.3062	1.6901	0.3779	0.0025	1.3114	1.5695	0.2314	1.00E-07	1.2261	1.0912	0.2381	1.70E-05
6%	0.2906	0.3865	0.1222	0.0163	1.0770	1.3788	0.3980	0.0150	1.3715	1.7564	0.3927	0.0023	1.3770	1.6251	0.2396	8.23E-08	1.2847	1.1247	0.2454	1.45E-05
7%	0.3175	0.3991	0.1262	0.0134	1.1262	1.4038	0.4052	0.0132	1.4389	1.8252	0.4081	0.0021	1.4446	1.6825	0.2481	6.83E-08	1.3450	1.1595	0.2530	1.25E-05
8%	0.3450	0.4123	0.1304	0.0112	1.1765	1.4295	0.4127	0.0117	1.5085	1.8966	0.4241	0.0020	1.5141	1.7416	0.2568	5.72E-08	1.4071	1.1956	0.2609	1.08E-05
9%	0.3733	0.4261	0.1347	0.0094	1.2282	1.4559	0.4203	0.0104	1.5803	1.9707	0.4407	0.0019	1.5857	1.8027	0.2658	4.83E-08	1.4711	1.2330	0.2691	9.43E-06
10%	0.4023	0.4404	0.1393	0.0080	1.2811	1.4831	0.4281	0.0092	1.6544	2.0476	0.4579	0.0018	1.6594	1.8657	0.2751	4.11E-08	1.5370	1.2718	0.2775	8.30E-06

S.S growth 4%

	Communication services				Consumer staples & discretionary				Energy, industrials & materials				Health care				Information technology			
	n = 10		H. mean = -6.95%		n = 12		H. mean = -6.90%		n = 20		H. mean = -1.08%		n = 46		H. mean = -15.4%		n = 21		H. mean = -11.1%	
P(fail)	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**
0%	0.1536	0.3168	0.1002	0.0530	0.8198	1.2372	0.3572	0.0301	1.0180	1.3907	0.3110	0.0037	1.0215	1.3156	0.1940	2.54E-07	0.9665	0.9400	0.2051	3.85E-05
1%	0.1764	0.3267	0.1033	0.0412	0.8618	1.2587	0.3634	0.0264	1.0736	1.4457	0.3233	0.0033	1.0779	1.3630	0.2010	2.00E-07	1.0167	0.9678	0.2112	3.16E-05
2%	0.1997	0.3370	0.1066	0.0324	0.9048	1.2807	0.3697	0.0232	1.1309	1.5028	0.3360	0.0030	1.1360	1.4120	0.2082	1.60E-07	1.0684	0.9967	0.2175	2.62E-05
3%	0.2237	0.3478	0.1100	0.0258	0.9490	1.3032	0.3762	0.0204	1.1901	1.5622	0.3493	0.0028	1.1958	1.4627	0.2157	1.29E-07	1.1217	1.0267	0.2240	2.19E-05
4%	0.2483	0.3591	0.1135	0.0208	0.9942	1.3264	0.3829	0.0180	1.2512	1.6238	0.3631	0.0025	1.2573	1.5149	0.2234	1.05E-07	1.1766	1.0579	0.2308	1.85E-05
5%	0.2735	0.3708	0.1173	0.0169	1.0405	1.3502	0.3898	0.0159	1.3142	1.6878	0.3774	0.0023	1.3207	1.5688	0.2313	8.63E-08	1.2332	1.0902	0.2379	1.57E-05
6%	0.2994	0.3831	0.1212	0.0139	1.0881	1.3746	0.3968	0.0140	1.3792	1.7542	0.3923	0.0022	1.3860	1.6244	0.2395	7.17E-08	1.2915	1.1238	0.2452	1.35E-05
7%	0.3259	0.3960	0.1252	0.0116	1.1368	1.3998	0.4041	0.0124	1.4464	1.8231	0.4077	0.0020	1.4532	1.6819	0.2480	6.01E-08	1.3515	1.1586	0.2528	1.17E-05
8%	0.3532	0.4093	0.1294	0.0098	1.1868	1.4256	0.4115	0.0110	1.5157	1.8947	0.4237	0.0019	1.5224	1.7411	0.2567	5.08E-08	1.4134	1.1948	0.2607	1.02E-05
9%	0.3812	0.4233	0.1338	0.0083	1.2381	1.4522	0.4192	0.0098	1.5872	1.9689	0.4402	0.0018	1.5937	1.8022	0.2657	4.33E-08	1.4772	1.2323	0.2689	8.90E-06
10%	0.4099	0.4377	0.1384	0.0071	1.2907	1.4795	0.4271	0.0087	1.6611	2.0458	0.4575	0.0017	1.6671	1.8653	0.2750	3.71E-08	1.5429	1.2711	0.2774	7.86E-06

Appendix VII

Additional test VI: Using linearly Decreasing growth rate

S.S growth 2%

	Communication services				Consumer staples & discretionary				Energy, industrials & materials				Health care				Information technology			
	n = 10		H. mean = -6.95%		n = 12		H. mean = -6.90%		n = 20		H. mean = -1.08%		n = 46		H. mean = -15.4%		n = 21		H. mean = -11.1%	
P(fail)	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**
0%	0.1247	0.3044	0.0963	0.0745	0.7612	1.2204	0.3523	0.0380	0.9371	1.3050	0.2918	0.0042	0.9377	1.2426	0.1832	3.59E-07	0.8973	0.9024	0.1969	5.22E-05
1%	0.1470	0.3137	0.0992	0.0569	0.8026	1.2417	0.3584	0.0333	0.9911	1.3577	0.3036	0.0038	0.9927	1.2887	0.1900	2.77E-07	0.9462	0.9291	0.2027	4.20E-05
2%	0.1700	0.3234	0.1023	0.0439	0.8450	1.2635	0.3647	0.0292	1.0469	1.4125	0.3159	0.0034	1.0494	1.3363	0.1970	2.16E-07	0.9966	0.9568	0.2088	3.42E-05
3%	0.1935	0.3336	0.1055	0.0343	0.8885	1.2859	0.3712	0.0256	1.1045	1.4696	0.3286	0.0030	1.1079	1.3856	0.2043	1.71E-07	1.0486	0.9856	0.2151	2.81E-05
4%	0.2176	0.3443	0.1089	0.0271	0.9331	1.3088	0.3778	0.0225	1.1640	1.5289	0.3419	0.0028	1.1681	1.4365	0.2118	1.36E-07	1.1023	1.0156	0.2216	2.33E-05
5%	0.2424	0.3556	0.1124	0.0216	0.9789	1.3324	0.3846	0.0198	1.2254	1.5906	0.3557	0.0025	1.2302	1.4891	0.2196	1.10E-07	1.1576	1.0468	0.2284	1.95E-05
6%	0.2679	0.3673	0.1162	0.0175	1.0259	1.3565	0.3916	0.0174	1.2889	1.6547	0.3700	0.0023	1.2942	1.5434	0.2276	8.99E-08	1.2147	1.0792	0.2355	1.65E-05
7%	0.2941	0.3796	0.1200	0.0143	1.0741	1.3814	0.3988	0.0153	1.3545	1.7213	0.3849	0.0022	1.3602	1.5996	0.2358	7.41E-08	1.2736	1.1129	0.2429	1.40E-05
8%	0.3210	0.3925	0.1241	0.0118	1.1236	1.4069	0.4061	0.0135	1.4223	1.7906	0.4004	0.0020	1.4282	1.6576	0.2444	6.16E-08	1.3343	1.1479	0.2505	1.20E-05
9%	0.3486	0.4059	0.1283	0.0099	1.1744	1.4332	0.4137	0.0120	1.4923	1.8625	0.4165	0.0019	1.4983	1.7175	0.2532	5.18E-08	1.3969	1.1843	0.2584	1.04E-05
10%	0.3770	0.4198	0.1328	0.0084	1.2265	1.4602	0.4215	0.0106	1.5647	1.9372	0.4332	0.0018	1.5706	1.7793	0.2623	4.38E-08	1.4615	1.2221	0.2667	9.09E-06

S.S growth 4%

	Communication services				Consumer staples & discretionary				Energy, industrials & materials				Health care				Information technology			
	n = 10		H. mean = -6.95%		n = 12		H. mean = -6.90%		n = 20		H. mean = -1.08%		n = 46		H. mean = -15.4%		n = 21		H. mean = -11.1%	
P(fail)	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**	**Mean**	**S.D**	**S.E**	**P-value**
0%	0.1359	0.2994	0.0947	0.0583	0.7755	1.2150	0.3507	0.0348	0.9470	1.3018	0.2911	0.0038	0.9495	1.2414	0.1830	2.83E-07	0.9060	0.9009	0.1966	4.62E-05
1%	0.1579	0.3089	0.0977	0.0450	0.8164	1.2364	0.3569	0.0305	1.0007	1.3547	0.3029	0.0034	1.0041	1.2876	0.1898	2.22E-07	0.9547	0.9276	0.2024	3.75E-05
2%	0.1804	0.3189	0.1009	0.0351	0.8583	1.2584	0.3633	0.0269	1.0562	1.4097	0.3152	0.0031	1.0604	1.3353	0.1969	1.76E-07	1.0048	0.9554	0.2085	3.08E-05
3%	0.2036	0.3294	0.1042	0.0277	0.9014	1.2810	0.3698	0.0236	1.1135	1.4668	0.3280	0.0028	1.1185	1.3846	0.2041	1.41E-07	1.0566	0.9843	0.2148	2.55E-05
4%	0.2275	0.3403	0.1076	0.0221	0.9456	1.3041	0.3764	0.0208	1.1727	1.5263	0.3413	0.0026	1.1783	1.4356	0.2117	1.14E-07	1.1100	1.0144	0.2214	2.13E-05
5%	0.2520	0.3518	0.1112	0.0179	0.9910	1.3278	0.3833	0.0184	1.2338	1.5881	0.3551	0.0024	1.2401	1.4883	0.2194	9.32E-08	1.1650	1.0457	0.2282	1.79E-05
6%	0.2771	0.3637	0.1150	0.0146	1.0376	1.3521	0.3903	0.0162	1.2971	1.6523	0.3695	0.0022	1.3037	1.5427	0.2275	7.70E-08	1.2219	1.0782	0.2353	1.52E-05
7%	0.3030	0.3762	0.1190	0.0121	1.0854	1.3771	0.3975	0.0143	1.3624	1.7191	0.3844	0.0020	1.3694	1.5989	0.2357	6.42E-08	1.2805	1.1120	0.2427	1.30E-05
8%	0.3296	0.3892	0.1231	0.0101	1.1345	1.4028	0.4050	0.0127	1.4299	1.7884	0.3999	0.0019	1.4371	1.6569	0.2443	5.40E-08	1.3410	1.1471	0.2503	1.12E-05
9%	0.3569	0.4028	0.1274	0.0086	1.1849	1.4293	0.4126	0.0113	1.4997	1.8604	0.4160	0.0018	1.5068	1.7169	0.2531	4.58E-08	1.4034	1.1835	0.2583	9.78E-06
10%	0.3850	0.4169	0.1318	0.0073	1.2366	1.4564	0.4204	0.0100	1.5718	1.9352	0.4327	0.0017	1.5788	1.7788	0.2623	3.91E-08	1.4678	1.2213	0.2665	8.56E-06

Appendix VIII – Results by industry category and individual company

Communication Services

Companies	Historical ROE	Implied ROE (SS growth 2%)	Implied ROE (SS growth 4%)
5th Planet Games A/S	-94%	9%	10%
Bambuser AB	-83%	-12%	-10%
Boliga Gruppen A/S	13%	19%	19%
Bublar Group AB	-95%	4%	5%
Enad Global 7 AB	27%	-14%	-13%
Everysport Media Group AB	-114%	59%	60%
MAG Interactive AB	12%	-63%	-59%
Next Games Oyj	-41%	2%	2%
Qiiwi Games AB	-45%	30%	31%
ZetaDisplay AB	-30%	-9%	-8%

Energy, Materials and industrials

Companies	Historical ROE	Implied ROE (SS growth 2%)	Implied ROE (SS growth 4%)
ArcAroma AB	-98%	282%	283%
Arctic Minerals AB	-23%	-11%	-10%
Arise AB	-2%	-47%	-44%
Climeon AB	-81%	149%	149%
Colabitoil Sweden AB	-11%	-55%	-51%
Electromagnetic Geoservices ASA	-67%	149%	149%
FlexQube AB	-37%	107%	107%
GomSpace Group AB	-9%	82%	83%
Hybricon Bus System AB	-138%	-5%	-4%
Maha Energy AB	-6%	148%	149%
Minesto AB	-12%	-34%	-30%
North Energy ASA	-53%	-10%	-9%
OrganoClick AB	-112%	104%	105%
Philly Shipyard ASA	0%	92%	92%
Plejd AB	-58%	13%	15%
Savosolar Oyj	13%	412%	412%
SolTech Energy Sweden AB	-71%	35%	36%
Swedish Stirling AB	-6%	8%	9%
WilLak AB	-40%	26%	27%
VOW ASA	0%	11%	13%

Consumer discretionary and consumer staples

Companies	Historical ROE	Implied ROE (SS growth 2%)	Implied ROE (SS growth 4%)
Axkid AB	72%	8%	10%
Blick Global Group AB	-83%	121%	122%
Clean Motion AB	-38%	40%	44%
Coegin Pharma AB	-41%	-53%	-50%
FirstFarms A/S	-2%	-40%	-37%
Gullberg & Jansson AB	7%	-10%	-10%
Net Trading Group NTG AB	-117%	404%	404%
Northbaze Group AB	-139%	28%	29%
Premium Snacks Nordic AB	64%	49%	50%
Scout Gaming Group AB	-88%	161%	161%
Simris Alg AB	-80%	2%	3%
Zenergy AB	-82%	-8%	-6%

Information technology

Companies	Historical ROE	Implied ROE (SS growth 2%)	Implied ROE (SS growth 4%)
Acconeer AB	-75%	10%	11%
BIMobject AB	-98%	51%	53%
Conferize A/S	-59%	288%	288%
Crunchfish AB	-69%	96%	96%
Enalyzer A/S	-25%	-9%	-9%
Eyeonid Group AB	-94%	295%	295%
Fastout Int. AB	-85%	120%	121%
Flowscape Technology AB	-131%	-7%	-6%
Gapwaves AB	-130%	128%	129%
Greater Than AB	-76%	21%	25%
Hitech & Development Wireless Sweden Holding AB	-82%	10%	11%
Motion Display Scandinavia AB	-31%	31%	32%
Napatech A/S	2%	-4%	-3%
Nepa AB	27%	90%	91%
Raybased Holding AB	-70%	34%	35%
Safeture AB	-107%	114%	114%
Seamless Distribution Systems AB	-10%	48%	49%
Siili Solutions Oyj	59%	17%	18%
Touchtech AB	-97%	100%	102%
Unibap AB	114%	18%	19%
Zaplox AB	-69%	55%	55%

Health care

Companies	Historical ROE	Implied ROE (SS growth 2%)	Implied ROE (SS growth 4%)
Abliva AB	-46%	51%	53%
AdderaCare AB	26%	-5%	-4%
Alzinova AB	-68%	17%	18%
Annexin Pharmaceuticals AB	-143%	-34%	-32%
AroCell AB	-93%	55%	55%
Ascendis Pharma A/S	6%	11%	13%
Bactiguard Holding AB	-23%	-20%	-19%
BerGenBio ASA	-78%	61%	63%
BiBBInstruments AB	-98%	31%	32%
Biovica International AB	-50%	7%	8%
BrainCool AB	-55%	142%	142%
Cline Scientific AB	-136%	532%	532%
Dextech Medical AB	-32%	277%	277%
Enzymatica AB	-80%	193%	196%
Episurf Medical AB	-69%	55%	56%
Forward Pharma A/S	28%	388%	389%
Hemcheck Sweden AB	-75%	16%	17%
Herantis Pharma Oyj	-39%	-57%	-54%
Immunovia AB	-71%	90%	91%
Invent Medic Sweden AB	-104%	151%	155%
IRRAS AB	-72%	101%	101%
Isofol Medical AB	-43%	63%	65%
iZafe Group AB	-87%	-60%	-56%
Karolinska Development AB	-10%	-28%	-26%
Kontigo Care AB	-79%	34%	35%
Medfield Diagnostics AB	-80%	200%	201%
Micropos Medical AB	-29%	29%	30%
Nanexa AB	-144%	15%	16%
Norda ASA	4%	20%	21%
Nordic Nanovector ASA	-84%	104%	104%
Orexo AB	-55%	39%	40%
Orphazyme A/S	-67%	36%	38%
PCI Biotech Holding ASA	-96%	6%	6%
PEPTONIC medical AB	-45%	-19%	-18%
PharmaLundensis AB	-116%	49%	53%
RhoVac AB	-115%	69%	69%
Saniona AB	10%	70%	71%
Scandinavian ChemoTech AB	-71%	15%	16%
Scandinavian Real Heart AB	-74%	87%	88%
SensoDetect Aktiebolag	-56%	138%	140%
SenzaGen AB	-57%	39%	40%
Spago Nanomedical AB	-16%	-18%	-16%
SynAct Pharma AB	54%	163%	164%
Vibrosense Dynamics AB	-66%	121%	122%
WntResearch AB	-121%	52%	53%
Xbrane Biopharma AB	-66%	5%	8%

Appendix IX – 10-year government bond rates for individual Nordic countries

	1998	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Norway	5.38%	4.35%	3.74%	3.99%	3.72%	2.38%	2.62%	2.93%	1.51%	1.48%	1.66%	1.56%	1.68%	1.40%
Sweden	6.81%	3.94%	3.12%	3.30%	3.35%	1.71%	1.99%	2.21%	0.65%	0.87%	0.74%	0.92%	0.39%	-0.05%
Finland	5.21%	4.04%	4.07%	3.43%	3.36%	2.27%	1.87%	1.77%	0.34%	0.58%	0.62%	0.81%	0.41%	-0.24%
Denmark	6.47%	4.07%	3.73%	3.57%	3.21%	1.75%	1.79%	1.70%	0.39%	0.62%	0.48%	0.73%	0.31%	-0.43%

Appendix X – Market risk premium for individual Nordic countries

Market Risk Premium Per Country

Annual Averages 2011 - 2020

Year	SE	FI	NO	DK
2011	5.9%	5.4%	5.5%	5.4%
2012	5.9%	6.0%	5.8%	5.5%
2013	6.0%	6.8%	6.0%	6.4%
2014	5.3%	5.6%	5.8%	5.1%
2015	5.4%	5.7%	5.5%	5.5%
2016	5.2%	5.5%	5.5%	5.3%
2017	6.8%	5.9%	6.1%	6.1%
2018	7.1%	5.9%	5.7%	6.0%
2019	6.1%	6.2%	6.0%	6.0%
2020	6.1%	6.5%	5.8%	6.1%
Average:	**6.0%**	**6.0%**	**5.8%**	**5.7%**
Source: Statista (2020)		**Average all:**		**5.9%**

Appendix XI – List of companies in sample

Companies	Exchange:Ticker	Country	Industry	RMB	Cost of equity without p(fail)	Market cap at t+1 (m)	ROE(ss)
5th Planet Games A/S	OB:HUGO	Denmark	Communication Services	**0.33**	4.02%	70.6	4.68%
Abliva AB	OM:ABLI	Sweden	Health Care	**0.62**	7.82%	142.5	11.43%
Acconeer AB	OM:ACCON	Sweden	Information Technology	**0.62**	8.03%	326.3	11.77%
AdderaCare AB	OM:ADDERA	Sweden	Health Care	**0.62**	3.52%	148.6	4.45%
Alzinova AB	OM:ALZ	Sweden	Health Care	**0.62**	4.62%	92.6	6.24%
Annexin Pharmaceuticals AB	OM:ANNX	Sweden	Health Care	**1.74**	11.51%	30.1	28.07%
ArcAroma AB	OM:AAA	Sweden	Industrials	**0.59**	5.20%	375.2	7.09%
Arctic Minerals AB	OM:ARCT	Sweden	Materials	**0.31**	4.13%	39.1	4.79%
Arise AB	OM:ARISE	Sweden	Energy	**1.74**	7.07%	1088.8	15.90%
AroCell AB	OM:AROC	Sweden	Health Care	**0.31**	7.57%	58.8	9.29%
Ascendis Pharma A/S	NasdaqGS:ASND	Denmark	Health Care	**0.72**	4.62%	454.6	6.51%
Axkid AB	NGM:AXKID	Sweden	Consumer Discretionary	**0.72**	4.16%	51.8	5.71%
Bactiguard Holding AB	OM:BACTI B	Sweden	Health Care	**0.72**	4.15%	373.0	5.70%
Bambuser AB	OM:BUSER	Sweden	Communication Services	**0.62**	3.73%	16.2	4.80%
BerGenBio ASA	OB:BGBIO	Norway	Health Care	**1.74**	11.37%	1460.8	27.68%
BiBBInstruments AB	NGM:BIBB	Sweden	Health Care	**0.72**	4.38%	116.0	6.09%
BIMobject AB	OM:BIM	Sweden	Information Technology	**0.76**	6.49%	235.3	9.90%
Biovica International AB	OM:BIOVIC B	Sweden	Health Care	**0.72**	5.50%	152.3	8.01%
Blick Global Group AB	NGM:BLICK	Sweden	Consumer Discretionary	**0.62**	2.83%	69.3	3.34%
Boliga Gruppen A/S	CPSE:BOLIGA	Denmark	Communication Services	**0.33**	4.84%	119.1	5.78%
BrainCool AB	NGM:BRAIN	Sweden	Health Care	**0.33**	7.01%	388.9	8.66%
Bublar Group AB	OM:BUBL	Sweden	Communication Services	**0.44**	1.43%	207.8	1.17%
Clean Motion AB	OM:CLEMO	Sweden	Consumer Discretionary	**1.74**	4.08%	143.1	7.71%
Climeon AB	OM:CLIME B	Sweden	Industrials	**0.33**	11.42%	2288.6	14.53%
Cline Scientific AB	NGM:CLINE B	Sweden	Health Care	**0.33**	6.47%	72.0	7.95%
Coegin Pharma AB	NGM:COEGIN	Sweden	Consumer Discretionary	**1.74**	4.92%	13.9	10.00%
Colabitoil Sweden AB	NGM:COLAB	Sweden	Energy	**1.74**	0.57%	109.4	-1.91%
Conferize A/S	CPSE:CONFRZ	Denmark	Information Technology	**0.33**	89.94%	94.3	118.95%
Crunchfish AB	OM:CFISH	Sweden	Information Technology	**0.33**	4.28%	305.0	5.04%
Dextech Medical AB	NGM:DEX	Sweden	Health Care	**0.33**	4.68%	446.1	5.56%
Electromagnetic Geoservices ASA	OB:EMGS	Norway	Energy	**0.33**	12.90%	320.5	16.49%
Enad Global 7 AB	OM:EG7	Sweden	Communication Services	**0.33**	-5.58%	168.5	-8.09%
Enalyzer A/S	CPSE:ENALYZ	Denmark	Information Technology	**0.33**	6.84%	7.7	8.44%
Enzymatica AB	OM:ENZY	Sweden	Health Care	**1.74**	5.44%	248.5	11.44%
Episurf Medical AB	OM:EPIS B	Sweden	Health Care	**0.33**	4.77%	143.4	5.68%
Everysport Media Group AB	NGM:EVERY A	Sweden	Communication Services	**0.62**	8.08%	9.6	11.86%
Eyeonid Group AB	NGM:EOID	Sweden	Information Technology	**0.33**	12.31%	677.0	15.71%
Fastout Int. AB	NGM:FOUT	Sweden	Information Technology	**0.33**	3.41%	82.8	3.88%
FirstFarms A/S	CPSE:FFARMS	Denmark	Consumer Staples	**1.74**	5.15%	645.6	10.62%
FlexQube AB	OM:FLEXQ	Sweden	Industrials	**0.47**	20.19%	342.0	28.73%
Flowscape Technology AB	NGM:FLOWS	Sweden	Information Technology	**0.33**	2.62%	36.2	2.83%
Forward Pharma A/S	NasdaqCM:FWP	Denmark	Health Care	**0.33**	3.33%	4467.6	3.77%
Gapwaves AB	OM:GAPW B	Sweden	Information Technology	**0.33**	6.58%	593.5	8.09%
GomSpace Group AB	OM:GOMX	Sweden	Industrials	**0.33**	6.67%	2258.1	8.21%
Greater Than AB	OM:GREAT	Sweden	Information Technology	**1.74**	3.05%	63.9	4.88%
Gullberg & Jansson AB	NGM:GJAB	Sweden	Consumer Discretionary	**0.33**	3.82%	11.7	4.42%

Hemcheck Sweden AB	OM:HEMC	Sweden	Health Care	**0.33**	0.14%	149.2	-0.48%
Herantis Pharma Oyj	HLSE:HRTIS	Finland	Health Care	**1.74**	1.63%	3.6	0.97%
Hitech & Development Wireless Sweden Holding AB	OM:HDW B	Sweden	Information Technology	**0.33**	12.72%	60.6	16.26%
Hybricon Bus System AB	NGM:HYCO	Sweden	Industrials	**0.31**	6.96%	18.7	8.49%
Immunovia AB	OM:IMMNOV	Sweden	Health Care	**0.33**	7.87%	1546.0	9.81%
Invent Medic Sweden AB	NGM:IMS	Sweden	Health Care	**1.74**	4.68%	109.9	9.35%
IRRAS AB	OM:IRRAS	Sweden	Health Care	**0.33**	13.18%	814.2	16.87%
Isofol Medical AB	OM:ISOFOL	Sweden	Health Care	**1.74**	14.94%	766.1	37.47%
iZafe Group AB	OM:IZAFE B	Sweden	Health Care	**1.74**	4.73%	7.8	9.48%
Karolinska Development AB	OM:KDEV	Sweden	Health Care	**0.68**	3.79%	742.5	5.00%
Kontigo Care AB	OM:KONT	Sweden	Health Care	**0.33**	3.73%	60.9	4.30%
MAG Interactive AB	OM:MAGI	Sweden	Communication Services	**1.74**	-0.85%	340.1	-5.80%
Maha Energy AB	OM:MAHA A	Sweden	Energy	**0.33**	9.01%	580.5	11.33%
Medfield Diagnostics AB	NGM:MEDF	Sweden	Health Care	**0.33**	2.97%	183.8	3.29%
Micropos Medical AB	NGM:MPOS	Sweden	Health Care	**0.33**	5.71%	70.4	6.93%
Minesto AB	OM:MINEST	Sweden	Industrials	**1.74**	6.31%	415.5	13.81%
Motion Display Scandinavia AB	NGM:MODI	Sweden	Information Technology	**0.33**	2.36%	41.6	2.48%
Nanexa AB	OM:NANEXA	Sweden	Health Care	**0.31**	2.62%	59.3	2.81%
Napatech A/S	OB:NAPA	Denmark	Information Technology	**0.28**	6.99%	162.4	8.38%
Nepa AB	OM:NEPA	Sweden	Information Technology	**0.33**	4.04%	507.5	4.71%
Net Trading Group NTG AB	NGM:NTGR	Sweden	Consumer Discretionary	**0.47**	10.82%	47.5	14.97%
Next Games Oyj	HLSE:NXTGMS	Finland	Communication Services	**0.33**	13.66%	19.7	17.51%
Norda ASA	OTCNO:NORD	Norway	Health Care	**0.31**	5.70%	216.3	6.85%
Nordic Nanovector ASA	OB:NANOV	Norway	Health Care	**0.33**	10.53%	4738.3	13.35%
North Energy ASA	OB:NORTH	Norway	Energy	**0.33**	7.12%	214.4	8.80%
Northbaze Group AB	OM:NBZ	Sweden	Consumer Discretionary	**0.31**	4.99%	41.9	5.92%
Orexo AB	OM:ORX	Sweden	Health Care	**0.33**	9.20%	1652.7	11.58%
OrganoClick AB	OM:ORGC	Sweden	Materials	**0.31**	2.46%	459.8	2.61%
Orphazyme A/S	CPSE:ORPHA	Denmark	Health Care	**1.74**	1.71%	864.4	1.21%
PCI Biotech Holding ASA	OB:PCIB	Norway	Health Care	**0.33**	10.98%	59.6	13.95%
PEPTONIC medical AB	NGM:PMED	Sweden	Health Care	**0.62**	3.18%	57.6	3.91%
PharmaLundensis AB	NGM:PHAL	Sweden	Health Care	**1.74**	4.61%	50.7	9.16%
Philly Shipyard ASA	OB:PHLY	Norway	Industrials	**0.33**	8.29%	548.9	10.36%
Plejd AB	NGM:PLEJD	Sweden	Industrials	**0.65**	5.49%	260.5	7.76%
Premium Snacks Nordic AB	NGM:SNX	Sweden	Consumer Staples	**0.59**	2.70%	53.9	3.11%
Qiiwi Games AB	NGM:QIIWI	Sweden	Communication Services	**0.33**	-1.44%	72.1	-2.57%
Raybased Holding AB	NGM:RBASE	Sweden	Information Technology	**0.33**	1.46%	95.9	1.28%
RhoVac AB	NGM:RHOVAC	Sweden	Health Care	**0.33**	2.73%	108.6	2.97%
Safeture AB	OM:SFTR	Sweden	Information Technology	**0.33**	0.89%	347.7	0.52%
Saniona AB	OM:SANION	Denmark	Health Care	**0.62**	5.39%	337.6	7.49%
Savosolar Oyj	OM:SAVOS	Finland	Industrials	**0.33**	5.19%	99.3	6.24%
Scandinavian ChemoTech AB	OM:CMOTEC B	Sweden	Health Care	**0.62**	5.61%	38.0	7.84%
Scandinavian Real Heart AB	NGM:HEART	Sweden	Health Care	**0.62**	1.67%	124.0	1.46%
Scout Gaming Group AB	OM:SCOUT	Sweden	Consumer Discretionary	**0.33**	6.70%	380.2	8.25%
Seamless Distribution Systems AB	OM:SDS	Sweden	Information Technology	**0.62**	1.34%	161.5	0.94%
SensoDetect Aktiebolag	NGM:SDET	Sweden	Health Care	**0.62**	6.34%	157.7	9.02%
SenzaGen AB	OM:SENZA	Sweden	Health Care	**0.33**	2.97%	505.0	3.28%
Siili Solutions Oyj	HLSE:SIILI	Finland	Information Technology	**0.59**	3.02%	22.0	3.62%

Simris Alg AB	OM:SIMRIS B	Sweden	Consumer Staples	**0.59**	3.13%	92.6	3.79%
SolTech Energy Sweden AB	OM:SOLT	Sweden	Industrials	**0.33**	7.38%	396.5	9.15%
Spago Nanomedical AB	NGM:SPAG	Sweden	Health Care	**0.62**	2.28%	46.4	2.45%
Swedish Stirling AB	OM:STRLNG	Sweden	Industrials	**0.33**	4.38%	559.6	5.17%
SynAct Pharma AB	NGM:SYNACT	Sweden	Health Care	**0.59**	5.19%	131.6	7.07%
Touchtech AB	LSE:0GIM	Sweden	Information Technology	**0.76**	-0.05%	50.6	-1.61%
Unibap AB	OM:UNIBAP	Sweden	Information Technology	**0.59**	2.73%	135.1	3.16%
Vibrosense Dynamics AB	NGM:VSD B	Sweden	Health Care	**0.59**	3.56%	125.4	4.48%
WilLak AB	NGM:WIL	Sweden	Industrials	**0.31**	-3.73%	18.2	-5.51%
WntResearch AB	NGM:WNT	Sweden	Health Care	**0.31**	7.29%	26.9	8.93%
VOW ASA	OB:VOW	Norway	Industrials	**0.59**	8.86%	99.3	12.91%
Xbrane Biopharma AB	OM:XBRANE	Sweden	Health Care	**1.74**	4.47%	391.7	8.76%
Zaplox AB	OM:ZAPLOX	Sweden	Information Technology	**0.62**	6.35%	157.3	9.05%
Zenergy AB	NGM:ZENZIP B	Sweden	Consumer Discretionary	**0.76**	3.70%	80.2	4.98%
ZetaDisplay AB	OM:ZETA	Sweden	Communication Services	**0.76**	5.73%	48.5	8.56%