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The Post IPO Performance of Nordic High-Growth Companies

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THE POST IPO PERFORMANCE OF NORDIC HIGH-GROWTH COMPANIES

Master Thesis

by

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ABSTRACT

We study Nordic high-growth IPOs, measuring firms' ability to meet the revenue growth expectations that their offer prices imply, and estimating the relationship between growth expectations and abnormal returns. We identify implied growth expectations as the revenue growth rates that satisfy IPO offer prices in our standardized DCF model. We find that Nordic high-growth IPOs meet expectations on average, are not underpriced – having average 1st day returns of -2.1%, and do not exhibit long-run underperformance – with average annual Fama French abnormal returns of 17%. Moreover, implied growth is negatively related to 1st day abnormal returns and positively related to long-run abnormal returns. We conclude that these relationships are consistent with an initial risk adjustment and a subsequent positive performance adjustment.

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List of Abbreviations

B/M: Book-to-Market
CAGR: Compounded Annual Growth Rate
DCF: Discounted Cash Flow
D/E: Net Debt-to-Equity
DKK: Danish Krone
EBIT: Earnings Before Interest and Taxes
EUR: Euro
FCF: Free Cash Flow
FX: Foreign Exchange
HML: Fama French High Minus Low Factor
IPO: Initial Public Offering
MKT: Fama French Market Factor
NOK: Norwegian Kroner
NOPLAT: Net Operating Profit Less Adjusted Taxes
OECD: Organization for Economic Cooperation and Development
P/E: Price-to-Earnings
P&L: Profit and Loss
RMW: Fama French Robust Minus Weak Factor
SMB: Fama French Small Minus Big Factor
SEK: Swedish Krona
USD: US Dollars
WACC: Weighted Average Cost of Capital
YoY: Year-on-year

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Introduction

High growth expectations may justify high valuations for IPO firms with poor fundamentals. But does post-IPO performance vindicate those growth expectations? And are results from previous studies which attempt to answer this question by analyzing US IPOs observed in other markets across the globe?

IPO markets in the Nordics (Norway, Sweden, Denmark, and Finland), are particularly appealing. The Nordic startup environment enjoys significant investments, which bodes well for future growth in Nordic IPO markets. In 2019, venture capital investments across the Nordics saw a 50 percent YoY increase (Argentum, 2019).

Therefore, we study Nordic high-growth IPOs. We measure firms' ability to meet the revenue growth expectations that their offer prices imply. We estimate implied growth expectations by using a standardized DCF model to identify the revenue growth rates that satisfy high-growth companies' offer prices. In the rest of our thesis, we interchangeably refer to these growth rates as implied expected revenue growth rates or implied growth rates.

Additionally, we examine the persistence of revenue growth rates from the pre-IPO period into the post-IPO period. We also study whether Nordic high-growth IPOs are underpriced and experience long-term return underperformance. Finally, we estimate the relationship between implied growth and IPO abnormal returns – both on the 1st day of trading in the long-term. We estimate long-term abnormal returns using a modified version of the Fama French European 5 factor model.

To base our study on a recent and relevant period, we analyze firms that have gone public from 2012 – 2017. Furthermore, we study Nordic IPOs instead of IPOs from a single Nordic country to have a wider base for our sample base without sacrificing homogeneity, noting that Nordic countries are often regarded as a single regional market due to their economic, social, and political similarities.

We have structured our analysis based on past research on firm growth and IPO return performance. However, we did not find any studies focusing on high-growth IPOs in the Nordics or elsewhere. We therefore view the contribution of our study as an investigation of whether previous findings about growth and IPO return performance also apply to high-growth firms specifically.

Previous studies show evidence that growth expectations deviate significantly from realized measures (Lakonishok, Shleifer, & Vishny, 1994; La Porta, 1996; La Porta, Lakonishok, Shleifer, & Vishny 1997). Chan, Karceski, and Lakonishok (2003) identify persistence in firms' revenue growth. As for IPO underpricing and long-term underperformance, some of the first researchers to document these phenomena were Ibbotson (1975) and Ritter (1991), respectively. Regarding the relationship between IPO abnormal returns and growth expectations at IPO, Purnanandam and Swaminathan (2004) provide suggestive evidence, documenting a positive relationship between overvaluation and 1st day abnormal returns and a negative relationship between overvaluation and long-term abnormal returns. In a more closely related study, Cogliati, Paleari, and Vismara (2011) derive the implied cash flow growth rates of IPO firms in France, Italy and Germany, showing that growth expectations are upward biased compared to ex post realizations, and that long-term returns are decreasing in that upward bias.

We find that Nordic high-growth companies: (1) meet growth expectations, on average; (2) do not have persistent revenue growth rates; (3) are not underpriced, having an average[1] 1st day return of -2.1%; (4) do not underperform in the long-term, with average[1] annual Fama French abnormal returns estimated at 17%; (5) suffer a decline of 12.6% in 1st day abnormal returns for each standard deviation of implied growth; and (6) earn an extra 12% in annualized Fama French abnormal returns for every standard deviation of implied growth.

We interpret the negative predictive relationship between 1st day abnormal returns and implied growth as a risk adjustment against offer prices, which is increasing in the aggressiveness of the growth expectations that justify those prices. Additionally, we interpret the positive predictive relationship between long-term abnormal returns and implied growth as an adjustment against risk-averse investors' initial skepticism, as investors realize that high-growth IPO firms can meet their initial growth expectations, on average.

The rest of this thesis is organized as follows: Section 1 presents our literature review, Section 2 summarizes our hypotheses, Section 3 discusses the methodology applied, Section 4 describes the data used and presents a preliminary analysis, Section 5 contains our results and analysis, and Section 6 concludes.

[1] We report winsorized means, with cutoffs at the 10th and 90th percentiles.

1 Literature Review

Past literature related to the post-IPO performance of high-growth firms encompasses the characteristics of high-growth firms and growth expectations, (over)valuation, underpricing, and long-run underperformance of IPO firms. These themes overlap to some extent in specific studies, such as that by Purnanandam and Swaminathan (2004), who study the effect of IPO overvaluation on the long-run performance of abnormal returns, while also assessing the sustainability of growth rates for IPO firms.

However, few studies specifically address Nordic IPOs in local markets, and we do not know of any studies focusing on high-growth IPOs in the Nordics or elsewhere. This motivates a discussion of IPOs from an international perspective, while also revealing a gap which our study can fill.

1.1 High-Growth Companies and Growth Expectations

Birch (1979) was a forerunning researcher in the study of high-growth companies. He coined the term "gazelle" to refer to companies in the highest growth percentiles. These firms had a minimum sales CAGR of 20 percent over the 5 years of operation prior to sample formation. Consequently, other researchers have used a sales CAGR threshold of 20 percent to identify high-growth firms, with adjustments to the period for CAGR calculation, e.g., ranging from 3 to 5 years (Fischer & Reuber, 2003; Nicholls-Nixon, 2005; Sims & O'Regan, 2006). McKinsey offers an alternative definition for high-growth companies: "those whose organic revenue growth exceeds 15 percent annually" (2015, p. 731). Following Birch (1979), we identify high-growth companies as those which surpass the 66th cross-sectional percentile of pre-IPO revenue CAGR, measuring CAGR with data *up to* 5 years prior to IPO.

Does the market believe that companies can sustain high revenue growth rates? The answer previous studies give is yes – but mistakenly so. Lakonishok et al. (1994) find evidence that investors extrapolate past growth performance into expectations about future growth performance, and that these expectations are grossly overestimated. La Porta (1996) finds stronger evidence for too extreme expectations than for extrapolation, and La Porta et al. (1997) confirm the pervasiveness of too extreme expectations through earnings announcement event studies. Whether the true nature of expectational errors is extrapolative or simply superlative, these three studies present expectational errors about growth – and not risk – as the explanation for the return outperformance of value stocks relative to growth stocks. This highlights the importance of getting growth expectations right and motivates a study such as ours, in which we focus on the performance and effects of growth expectations in a sub-universe of companies for which growth is an identifying characteristic.

If investors indeed extrapolate past growth performance, what are the chances that they are *not* mistaken? And does it make any difference that one extrapolates the performance of high-growth firms? Chan et al. (2003) answer these questions by testing the persistence of growth across numerous operating measures, including revenues. The authors identify persistence when the percentage of companies which surpass median growth for 5 consecutive years exceeds what chance would dictate. Furthermore, they report that 10 percent of the companies in their sample sustained growth above 18 percent for 10 consecutive years – meaning McKinsey would classify them as high-growth firms (2015, p. 731). Chan et al. (2003) find that growth persistence obtains only for sales; it is inexistent for earnings. Moreover, the authors conclude that the median growth rate of operating performance across all indicators was close to the growth rate of gross domestic product over their sample period. Thus, the study confirms the error inherent to extrapolation, and that high-growth firms do not mitigate this error.

The referred studies consider US companies. One might wonder whether their results hold in other markets. Cogliati et al. (2011) examine French, Italian and German IPO markets in the period of 1995 – 2001. Their study shows that ex ante cash flow growth estimates are overoptimistic with relation to ex post realizations, and that post-IPO return performance is lower for companies which have more upward-biased ex ante cash flow growth assumptions. These results offer a reminder about the importance of growth expectations and they confirm that the problem of expectational errors is not limited to the US.

1.2 IPO Valuation

Kim and Ritter (1999) conducted the first systematic study of the usefulness of multiples in IPO valuations. They find that multiple valuation with P/E, price-to-sales, enterprise value-to-sales, and enterprise value to operating cash flow ratios of comparable firms affords only low valuation precision because of the wide distributions for the ratios even within specific industries. Moreover, the authors find that while using forecast earnings to calculate P/E ratios substantially improves valuation accuracy, valuation accuracy remains lower for younger firms than for older ones. Kim and Ritter (1999) also find that the largest component of IPO valuations is attributable to growth opportunities, meaning this is also where the largest share of estimation error may lie.

Indeed, Purnanandam and Swaminathan (2004) prove that overvaluation relative to peers at the time of IPO is positively associated with higher analyst growth forecasts and that growth projections for overvalued IPOs fail to materialize. Furthermore, the authors find that overvaluation is positively related to 1st day returns but negatively related to long-term risk-adjusted returns. These findings are consistent with mispricing views (Ritter, 1991; Loughran & Ritter, 1995), but they contradict asymmetric information theories of IPO pricing related to first day returns (Section 1.3). An important motivation for our thesis arises from the study by Purnanandam and Swaminathan (2004), as it not only vindicates the importance of growth assumptions to IPO valuations, but also relates growth assumptions to IPO return performance (albeit indirectly).

Other research has attempted to find the reasons for excessive optimism in the valuation of IPO firms. These range from undergoing a global market listing (Hasan, Kobeissi, & Wang, 2010), to being a university-based firm (Bonardo, Paleari, & Vismara, 2011), to having a dominant share of domestic sales and therefore less exposure to agency risks from international operations (Lipuma, 2012), to the presence and increase of retail investor attention, proxied by Google search volume (Colaco, De Cesari, & Hegde, 2017).

1.3 IPO Underpricing

Colloquially known as "money left on the table," underpricing is the additional price per share that hypothetically could have been charged in an IPO. Ibbotson (1975) was one of the first researchers to document underpricing, observing that US IPOs in the 1960s had an initial positive performance of 11.4 percent.

Numerous theories have emerged attempting to explain underpricing. Rock (1986) proposes an information asymmetry model where IPO buyers consist of two groups – informed and uninformed – and underpricing consists in compensation for the uninformed group's disadvantage. The signaling hypothesis by Welch (1989) contends that underpricing is an indicator of high-quality used to secure higher proceeds in seasoned equity offerings. Loughran and Ritter (2002) offer an explanation using prospect theory, stating that: (1) issuers determine their net loss or gain by conditionally integrating underpricing losses with gains from offer price upward adjustments, (2) underwriters obtain indirect compensation from underpricing through quid pro quos with investors, whenever these exceed gross spreads on a per-dollar basis.

The theoretical view of underpricing (and subsequent long-term underperformance) most closely associated with the empirical relationship between IPO growth assumptions and returns (Cogliati et al., 2011) is that “firms take advantage of transitory windows of opportunity by issuing equity when, on average, they are substantially overvalued” (Loughran & Ritter, 1995). Earlier, Ritter (1991) qualifies overvaluation as over-optimism about the earnings potential of young growth companies. Miller’s divergence of opinion hypothesis (1977) also offers an explanation: in a market with risk and divergence of opinions, a large enough group of optimistic investors that is unopposed by short sellers will drive the demand for a particular security, pushing its price up and its expected returns down.

1.4 IPO Return Performance

Ibbotson and Jaffe (1975) were some of the first researchers to document the “hot issue” markets, which consists of “periods in which the average first month performance (or aftermarket performance) of new issues is abnormally high.” Addressing this study, Ritter (1991) investigated the underperformance of US firms that went public in the period 1975 – 1984. Specifically, Ritter compared the 3-year holding period performance of IPO companies from his sample against that of listed size and industry matched comparable firms. The results indicate that on average, IPOs underperform listed comparables. Afterwards, using IPO data from 1970 to 1990, Loughran and Ritter (1995) found that the average annual return in a 5-year holding period for IPO stocks was approximately 5 percent, whereas listed size-matched comparables enjoyed an average annual return of 12 percent over the same period. Our research enables us to observe whether the “new issues puzzle” of underperformance holds for Nordic high-growth companies which went public from 2012 – 2017.

Research has attempted to explain and/or qualify IPO underperformance in response to the study by Loughran and Ritter (1995). Brav and Gompers (1997) find that IPO firms do not underperform their size comparables when assessing performance differences with the Fama-French 3 factor model. Moreover, the study reveals that underperformance is related to low size and B/M measures, such that it is not an IPO-effect, but a characteristic effect. Eckbo and Norli (2000) also address the “new issues puzzle” (Loughran & Ritter, 1995). The researchers show that IPO firms underperform because they are less risky according to their loadings on risk factors related to leverage and liquidity.

More recently, Gandolfi, Regalli, Soana and Arcuri (2018) address IPO underpricing and underperformance, focusing on IPOs in Italy, France and Germany in the period 1997 – 2011. The authors find that even though the countries had a similar pattern in underpricing, their differences in long-run underperformance were significant. These findings underscore the importance of analyzing IPO phenomena in geographies other than the US, as we do.

1.5 IPOs Internationally

Regarding the international perspective on IPOs, most research has focused on the IPO markets in the US, Europe, and Asia. IPOs in the Nordic countries have not attracted much attention. Most of their coverage originates from the global studies that include the Nordics in their sample. Furthermore, we found no studies that focus on Nordic IPOs and address high-growth companies.

The research on US IPOs that is most relevant to international perspectives on IPOs is concerned with foreign firm cross-listings. Echoing Loughran and Ritter (1995), Foerster and Karolyi (2000) document that foreign issuances in the US underperform US comparable firms by 8-15 percent over the 3 years following issuance. The study's sample includes IPOs, SEOs, and cross-listings. Other studies attempt to identify the causes for underpricing of foreign IPOs in the US. Bell, Moore, and Al-Shammari (2008) conclude that a lower degree of economic freedom in the country of origin corresponds to higher underpricing. Francis, Hasan, Lothian, & Sun, (2010) find that firms from segmented markets use underpricing to signal their quality and thereby improve their chances of having successful future SEOs. The authors' results are consistent with Welch's signaling hypothesis (1989).

Cross-listings are also studied globally with samples that include the Nordic countries. These studies focus on the justification for choosing a specific country for listing and on the reasons why firms should cross-list at all. Using a global sample that includes all Nordic countries, Sarkissian and Schill find that the choice of overseas listing venue predominantly depends on geographic, economic, cultural, and industrial proximity (2004). They also document evidence that cross-listings are associated with transitory valuation gains (2009). Fernandes and Giannetti (2014) conclude that firms list in countries with better investor protection, although they are less likely to list in countries with excessively stronger investor protection. Their sample covers 29 exchanges in 24 countries, including Sweden, Norway, and Denmark.

Global IPO studies encompassing the Nordics also address return performance and market microstructure. For instance, Loughran, Ritter and Rydqvist (1994) research the short-run and long-run performance of IPOs internationally, including Sweden and Finland in their sample. Their results show substantial variation in initial returns[2] across countries (e.g., the average for Malaysia was 80.3 percent, while for Finland it was 9.6 percent). The researchers associate differences across countries with “(i) different selling mechanisms, (ii) differences in the characteristics of the firms going public, and (iii) institutional constraints.” These differences notwithstanding, in 9 out of 25 countries in the study for which sufficient data is available, IPOs are underpriced in the short run and exhibit relatively low returns in the long run. Torstila (2003) analyzes clustering of underwriter gross spreads in 27 different IPO markets, including all Nordic countries. He concludes that there is less clustering in Europe than in the US, although Germany, France, and Belgium exhibit clustering. He also concludes that clustering is non-collusive because it is most pronounced in countries with the lowest gross spreads.

We now turn to studies that focus on IPOs in the Nordics. None of these studies we were able to find address high-growth firms, so we believe that our thesis offers a fresh perspective on the topic. Using a sample of Swedish IPOs from 1995 to 2001, Bodnaruk, Kandel, Massa, and Simonov (2008) find that IPO companies held by less diversified controlling shareholders suffer from larger underpricing. Westerholm (2006), who studies Nordic IPOs from 1991 to 2002, concludes that industry clustering of IPOs is positively related to underpricing but negatively related to long-run performance. The author notes that asymmetric information theories do not predict this result, since such theories dictate that underpricing increases with lack of access to information, but industry clustering increases information availability. More recently, using a sample from the Oslo Stock Exchange, Fjesme (2016) studies the practice of generating price support by using IPO allocations to condition after-listing purchases of other IPO shares. The author concludes that price support is pernicious to secondary – typically small – investors,

[2] Loughran et al. (1994) measure initial returns as “the equally-weighted percentage price change from the offering price to a market price at which subsequent daily returns are close to zero.” The period lasts 1 day for most countries but may consist of weeks or months.

and that after suffering losses related to price support once, these investors rationally reduce their participation in secondary markets of IPOs with price support.

1.6 IPO Valuation and Returns in an International Setting

The international nuances of IPOs elicit the question: what is the correct model for measuring IPO abnormal returns? Possible solutions for our study's purpose include use of "comparables," local market betas, and implied cost of capital measures. Foerster and Karolyi (2000) measure the abnormal returns of foreign firms listed in the US by matching them to comparable firms in each local market. This is not a viable workaround for our purposes because it would force us to reduce our already small sample (86 high-growth firms) due to the inexistence of local close comparables for many of the firms we study. Sarkissian and Schill (2009) use local market betas to estimate abnormal returns. While this could be a viable methodology, it introduces unwanted modeling complexity due to the large number of indices and risk-free rate proxies that would be required to simply derive WACC estimates for the firms in our sample under our chosen methodology (Sections 3.2.2-3.2.3). Frank and Shen (2016) state that the implied cost of capital is an increasingly used alternative methodology, which they also employ in their study of the firm-level relationship between cost of capital and investment. But implementing this methodology requires access to the Institutional Brokers' Estimate System (I/B/E/S) data set, which we lack.

Therefore, we opt to use the Fama French developed countries data for WACC estimation (Section 3.2.3) and to employ a modified version of the Fama French European 5 factor model to estimate post-IPO abnormal returns (Section 3.5). We recognize that this trades off model tractability against estimate precision, given prior research about the international applicability of the Fama-French factors (Griffin, 2002; Fama & French, 2017; Barrillas & Shank, 2018).

2 Hypotheses

2.1 Return Performance Hypotheses

Hypothesis 1: Nordic high-growth IPOs experience underpricing, i.e., positive first day returns.

This expectation is based on the "windows of opportunity" hypothesis (Ritter, 1991; Loughran & Ritter, 1995) and the "divergence of opinion" hypothesis

(Miller, 1977). Furthermore, we offer the possibility that these hypotheses are complementary with respect to underpricing: a lack of short sellers allows for short-term persistence of the over-optimism that motivates issuer opportunism. Our analysis also considers the positive relationships between underpricing and overvaluation (Purnanandam & Swaminathan, 2004) and between underpricing and implied growth expectations (Cogliati et al., 2011), which provide evidence in favor of the aforementioned hypotheses.

Hypothesis 2: Nordic high-growth IPOs experience negative long-term abnormal returns.

The "windows of opportunity" hypothesis (Ritter, 1991; Loughran & Ritter, 1995) states that long-term underperformance follows from disappointment after initial over-optimism. Miller's "divergence of opinion" hypothesis (1977) forecasts long-term underperformance under two lines of reasoning: (1) optimists drive lower risk-premia consistently over time, or (2) diffusion of uncertainty and divergence of opinions over time cause initial optimists to lower their original appraisals. Considering the evidence of too-extreme initial growth expectations and subsequent valuation adjustments (Lakonishok et al., 1994; La Porta, 1996; La Porta et al., 1997), we subscribe to the "windows of opportunity" view (Ritter, 1991; Loughran & Ritter, 1995) and the second line of reasoning in the "divergence of opinion" view (Miller, 1977).

2.2 Growth Hypotheses

Hypothesis 3: Post-IPO revenue growth underperforms implied expected revenue growth.

We recall Kim and Ritter's finding that the largest component of IPO valuations is attributable to growth opportunities (1999). An implication of this finding is that IPO overvaluation during "windows of opportunity" (Ritter, 1991; Loughran & Ritter, 1995) or under a "divergence of opinion" (Miller, 1977) is mainly due to over-optimistic growth expectations. We test whether growth expectations at IPO are over-optimistic by regressing post-IPO growth on implied expected revenue growth – our proxy for revenue growth expectations – and testing the null hypothesis that the intercept is equal to 0 and the slope coefficient is equal to 1. We expect to reject the null.

Hypothesis 4: Pre-IPO revenue growth exhibits persistence post-IPO.

Chan et al. (2003) document this phenomenon in American markets, while Hall, Jason and Tochterman (2008) do so in Australian markets. Chan et al. (2003)

explain that growth persistence may reflect favorable and long-lasting shifts in customer demand, market penetration, or product innovation – all of which are reasonable expectations for the firms in our sample. We test our hypothesis by regressing post-IPO growth on pre-IPO growth and testing the null hypothesis that the intercept is equal to 0 and the slope coefficient is equal to 1. We expect to fail to reject the null.

Hypothesis 5a: There is a positive relationship between implied expected revenue growth and 1st day abnormal returns.

The implication from Kim and Ritter's findings (1999) that high growth expectations drive "windows of opportunity" should result in positive 1st day abnormal returns when a lack of short sellers allows "windows of opportunity" to persist in the short-term. We test this hypothesis with a firm-level cross-sectional regression of 1st day abnormal returns on implied growth a set of control variables.

Hypothesis 5b: There is a negative relationship between implied growth and long-term abnormal returns.

We also identify the implication that the over-optimistic growth expectations that drive "windows of opportunity" either (1) result in disappointment over the long-term or (2) revert to average expectations as uncertainty and divergence of opinions about firm performance decrease over time. In either case, the result should be a downward adjustment in valuations. We test this hypothesis with a firm-level cross-sectional regression of long-term abnormal returns on implied growth.

3 Methodology

In this section, we specify the methodology we use in our study. We introduce the criteria for identifying high-growth IPOs and the valuation techniques used to obtain implied expected revenue growth rates. Additionally, we discuss the way we measure high-growth IPO firms' ability to meet their initial growth expectations, estimate abnormal returns, examine the relationship of abnormal returns to implied growth rates, and assess the robustness of the former tests. All returns and financial statement items are expressed in NOK to adopt the perspective of a Norwegian investor. Appendix 6 displays a flow chart summarizing our methodology.

3.1 Identification of High-Growth IPOs

We categorize high-growth IPOs as those whose pre-IPO revenue CAGR is above the cross-sectional 66th percentile. This approach is analogous to the one in the Birch's study (1979). We measure pre-IPO revenue CAGRs over the 5-year window prior to each IPO date. Several firms in our sample lack full data for this period.

3.2 Valuation and Implied Expected Growth Rates

3.2.1 Adapted DCF Valuation

We use DCF valuation to derive implied expected revenue growth rates. In choosing this approach, we consider McKinsey's appraisal that alternative valuation methods, such as P/E multiples, yield imprecise results when earnings are volatile (Inc., Koller, Goedhart, & Wessels, 2015, pp. 731). Furthermore, we observe evidence of such volatility in our sample (Table 7).

The basic steps for the DCF method are to discount unlevered free cash flow at the WACC[3], add non-operating assets to the discounted cash flows, and subtract nonequity claims, thereby arriving at estimated market capitalization (Inc. et al., 2015, p. 140). McKinsey proposes an adapted DCF framework for high-growth companies. The adaptation consists in valuing companies based on long-term (10-15 years), steady-state estimates for the development of key variables encompassing revenue growth and operating profitability, working backward from long-term estimates to intermediate, explicit modeling period estimates (Inc. et al., 2015, pp. 731-741).

We use this adaptation with a 10-year horizon for linear convergence to long-term, steady-state estimates. We make peer-based estimates for each IPO by selecting established peers for each IPO firm, measuring average historical estimates by peer, and setting our long-term estimates equal to the cross-sectional medians of those averages. Throughout all valuation exercises, we adopt a forward-looking perspective as of each high-growth IPO date.

3.2.2 Peer Selection and Analysis

The peers in our sample have at least 5 years of operations as publicly traded companies by the time of the IPO of the corresponding high-growth firm.

[3] We assume constant, long-term debt-to-equity ratios for peers and high-growth IPOs to justify our use of the WACC as a discount rate.

Moreover, we select peers only from Norway, Sweden, Denmark, Finland, France, Germany, Netherlands, Switzerland, Japan, UK, and USA. We select at least 1, but not more than 5 peers in the same industry sector according to Eikon's industry categorization. We choose those companies with the most operational similarity to each high-growth IPO firm, based on the business descriptions provided in Eikon.

Historical averages for each peer are based on 10-year-windows, with the IPO year for the corresponding high-growth firm as the point of reference (e.g., the analysis window for an IPO in 2017 is 2007-2016). The variables for which we take averages are book D/E ratios, EBIT margins, EBIT-to-FCF conversion ratios, and implied cost of debt. We estimate implied cost of debt as interest expense divided by the 1-year lag of net debt. Furthermore, we compute FCF exclusive of acquisitions, under the assumption that these are not part of peers' nor of high-growth IPO firms' daily operations. Appendix 5 provides further details about the computation of D/E ratios, implied cost of debt, and the components of FCF.

Additionally, for each peer, we estimate the industry unlevered cost of capital based on the peer's levered equity return, average historical D/E ratio, and average implied cost of debt. We use monthly Fama-French developed countries data to estimate market betas and levered equity returns. The period for the corresponding regressions is May 2010 until the month prior the date of the corresponding high-growth firm. The starting date is the same as for the oldest available observation of FX rates downloaded from Eikon. We estimate the expected values for the market factor and the risk-free rate by annualizing the historical arithmetic average of each monthly series as of each IPO date, subject to the boundaries given in the Section 3.2.3. We then estimate levered equity returns as the sum of the risk-free rate and the product of market betas with the market factor. Lastly, we estimate industry unlevered returns using Modigliani and Miller's Proposition II (1958), which we specify in equation 1 (r_e stands for CAPM levered equity returns, r_u is unlevered return, and r_d is the pre-tax cost of debt).

$$r_e = r_u + \frac{D}{E}(r_u - r_d) \tag{1}$$

3.2.3 Assumptions: Peer-Based Variables and Capital Markets

Based on the adoption of a forward-looking valuation perspective, we make assumptions about the boundaries for our peer-based estimates. We apply a lower boundary of 1 percent to EBIT margins, since a positive EBIT margin is necessary for IPO prices to be larger than zero. Similarly, we constrain EBIT-to-FCF conversion ratios with a lower boundary of 1 percent and an upper boundary of 1 minus the relevant statutory tax (this is consistent with valuing companies based on their operations). D/E ratios 0 zero as a lower boundary for non-financial firms, as we do not expect these to become net lenders within 10 years. For the implied cost of debt, the lower boundary is the maximum of the equal-weighted average 10-year Nordic government bond rate in the corresponding IPO year and 2 percent. We use 2 percent since this is the estimate of long-term inflation for OECD countries (2020a). The upper boundary for the implied cost of debt is 20 percent. This second condition is based on the distribution of implied cost of debt for peers, which we show in Section 4.4.

To derive WACC estimates, we combine the median values for implied cost of debt, D/E ratio and unlevered cost of capital. We re-lever the unlevered cost of capital as in equation 1, using the implied cost of debt and D/E ratio estimates. This leads to a raw levered equity return estimate and an implied market beta (levered equity returns less the expected risk-free rate, divided by expected market excess returns). Subsequently, we apply Blume's adjustment[4] to the implied beta and use the adjusted beta to compute an adjusted CAPM levered equity return. As with peers, we estimate market excess return and the risk-free rate as constrained historical arithmetic averages as of each IPO date. We use monthly Fama French developed country data, and we bound market excess return between 5.5 and 10 percent, while applying a lower boundary of 2 percent for the risk-free rate. As a final step, we calculate WACC according to equation 2, using statutory tax rates for each Nordic country.

$$WACC = \frac{E}{D+E} r_e + \frac{D}{D+E} r_d (1 - \tau) \tag{2}$$

3.2.4 Calculation of Implied Expected Growth

With the above in place, we identify the revenues, EBIT margin, EBIT-to-FCF conversion ratio, nonoperating assets, and nonequity claims in the fiscal year prior to IPO. We then model linear convergence of these ratios to peer-based assumptions. Additionally, we model revenue growth at the implied growth rate, assigning a temporary dummy growth rate. We calculate terminal value based on

[4] Blume's adjustment consists in computing a weighted average market beta, where 1/3 of the weight is assigned to the average market beta under the assumption of mean reversion: $\beta_{adj} = 1/3 + (2/3)\beta_{raw}$.

the Gordon Growth Model. Moreover, we assume a terminal growth rate of 2 percent for FCF, consistent with the historical estimate of long-term inflation for OECD countries (2020a), and with evidence of the deterioration of operating performance indicators distinct from revenue growth (Chan et al., 2003). Regarding non-equity claims, we deduct convertible debt at book values and operating leases at present value. We discount operating leases at the cost of debt, using 1-year discrete periods.

The last step of the IPO valuation process is to estimate implied growth rates – the modeling period revenue growth rates that satisfy each offer price. We use non-linear methods (Excel solver) to do this. In our view, this setup constitutes a base case scenario. Hence, we interpret the implied growth rates we derive as implied *expected* revenue growth rates. This mitigates the concern of subjectivity related to developing optimistic and pessimistic scenarios with their corresponding probabilities, and it eliminates concerns about the inability to match such scenarios with predominant market views.

We close this section by noting that our methodology for deriving implied growth rates differs from the one that Cogliati et al. (2011) develop. They measure FCF growth, and so are not concerned with revenue levels, EBIT margins, nor EBIT-to-FCF in the valuation period. Additionally, Cogliati et al. (2011) obtain WACC and terminal growth assumptions from IPO prospectuses, which were not available for all firms in our sample. Cogliati et al. (2011) also dispense with peer selection, so this process introduces no subjectivity into their valuations, unlike in our study, despite the need we have for peer firms.

3.3 Valuing Financial Companies

We also follow McKinsey when valuing financial companies such as banks and brokerage firms. Hence, we use the equity discounted cash flow method and thereby directly value both operational and financial cash flows. We calculate equity cash flow as follows:

$$CFE_t = NI_t - \Delta RE_t \tag{3}$$

where NI_t is Net Income and ΔRE_t is the change in retained earnings, and t is a subscript indicating the current period.

We discount cash flow to equity using our estimate of adjusted levered equity return (Section 3.2.3). The exceptions to this are that: (1) D/E ratios are unbounded for financial firms, and (2) instead of deriving a peer-based estimate for the cost of debt, we assume that the cost of debt is equivalent to the equal-weighted average of 10-year government bond rates across the Nordics on the year of IPO.

Additionally, in financial firm valuations, our peer-based assumptions of terminal ratios correspond to profit margins and net income to CFE ratios, not EBIT margins and EBIT-to-FCF ratios. Hence, linear convergence of IPO firm ratios also corresponds to the former pair of ratios. The rest of the valuation process and the calculation of implied growth is identical to the procedure we have described in Section 3.2.

3.4 Assessment of the Quality of Valuation Assumptions

We examine high-growth IPO firms' ability to meet their initial growth expectations by performing a firm-level cross-sectional regression of post-IPO revenue CAGRs on implied growth rates as a proxy for growth expectations. We use White's heteroscedasticity-consistent standard errors to account for firm idiosyncrasies. The regression takes the form shown in equation 4, where G_i represents realized revenue CAGRs, $G(imp)_i$ represents implied growth, α is the intercept, and *i* is an index for the firms comprised in our sample. we should find a significant positive intercept. We test these implications through a joint test, under the null hypothesis that the intercept is equal to 0 and the slope coefficient is equal to 1.

$$\hat{G}_i = \alpha + \beta_{G(imp)} G(imp)_i \tag{4}$$

The persistence of pre-IPO revenue growth into the post-IPO period is analyzed using a similar regression specification, in which 5-year pre-IPO revenue CAGR replaces implied growth as the dependent variable in equation 4. While persistence in revenue growth is not an assumption in our model, it may be considered a widespread assumption based on evidence of extrapolation (Lakonishok et al., 1994). Moreover, previous studies document evidence for persistence in revenue growth (Chan et al., 2003; Hall et al., 2008).

Similar analysis is also performed to measure the divergence of average post-IPO realizations from our initial assumptions for EBIT margins, EBIT-to-FCF conversion ratios, D/E ratios, and cost of debt, as shown in equations 5 – 8. For cost of debt, we regress average realized *implied* cost of debt on our assumption for cost of debt.

$$\widehat{EBITm_i} = \alpha + \beta_{EBITm(assum)} EBITm(assum)_i \tag{5}$$

$$\widehat{FCF/EBIT_i} = \alpha + \beta_{FCF/EBIT(assum)} FCF/EBIT(assum)_i \tag{6}$$

$$\widehat{D/E_i} = \alpha + \beta_{D/E(assum)} D/E(assum)_i \tag{7}$$

$$r_d\widehat{(imp)} = \alpha + \beta_{r_d(assum)} r_d(assum)_i \tag{8}$$

Our cut-off year for measuring all post-IPO realized values is 2018.

3.5 Abnormal Returns and Implied Growth Rates

Our approach to calculating abnormal returns and to running cross-sectional regressions generally resembles that of Purnanandam and Swaminathan (2004) in analyzing the relationship between overvaluation and abnormal returns. We report 1st day abnormal returns as the 1st day return of each IPO, net of the market and risk-free rate returns at the date of IPO, using daily Fama French European 5 Factor data. Our estimates of long-term abnormal returns are the annualized intercepts of IPO firms according to the Fama French 5 Factor Model (2015) excluding the CMA Factor. We exclude CMA based on the conclusions that Fama and French draw about the performance of their 5-factor model in an international setting (2015). Furthermore, our time series extend from 6 months after IPO (to allow for lockdown periods to expire) until December 2018. The minimum estimation time frame is 6 months (for the most recent IPOs).

Next, we examine the relationship between abnormal returns and implied expected revenue growth with the expectation that implied growth is positively related to 1st day abnormal returns and negatively related to long-term abnormal returns.

To take a first glance at the relationship of interest, we group firms into implied growth terciles and obtain each group's mean 1st day abnormal return and mean long-term abnormal return. Subsequently, we regress abnormal returns on implied growth cross-sectionally to examine the relationship between the two at the firm level. In the regression for 1st day abnormal returns, we control for the natural log of B/M ratios to account for return predictability, the natural log of sales in the fiscal year prior to IPO as a control for size, and EBIT margin in the fiscal year prior to IPO as a control for profitability, yielding the form shown in equation 9. We compute B/M ratios as book equity in the fiscal year prior to IPO divided by market capitalization at 1st day close. Appendix 5 provides further details about the computation of this variable. For long-term abnormal returns, the cross-sectional regression takes its form as in equation 10. Here, the Fama French time-series regressions have already addressed the desired control factors.

$$\widehat{R(1d)}_i = \alpha + \beta_{G(imp)} G(imp)_i + \beta_{bm} bm_i + \beta_{Sales} sales_i + \beta_{EBITm} EBITm_i \quad (9)$$

$$\hat{R}_i^* = \alpha + \beta_{G(imp)} G(imp)_i \quad (10)$$

As before, we use White's heteroscedasticity-consistent standard errors to account for firm idiosyncrasies.

3.6 Tests of Robustness

As initial tests of robustness for the relationships between abnormal returns and implied expected revenue growth, we run the same regression specifications in equations 9 and 10 but include the financial high-growth firms in our sample. Returning to the subsample without financial firms, for both specifications, we allow for variants of implied growth: de-meaned, standardized, and centered at 2 percent (by subtracting 2 percent). The rationale for centering at this level is that if the market expects inflation to grow at 2 percent, which is the measure we obtain from OECD estimates (2020a), then any cross-sectional growth variation which is significant to returns should occur relative to 2 percent. In regressions involving long-term abnormal returns, we test each variant of implied expected revenue growth by also including the R^2 from our Fama French time-series regressions as a control variable. Specifically, we aim to control for the effect of the imprecision of the model on the estimation of abnormal returns.

We complement these tests by answering the question: are realized measures of revenue growth better able to explain IPO abnormal returns? Our chosen method is to compute average 1st day abnormal returns by pre-IPO revenue CAGR tercile, substitute pre-IPO revenue CAGR for implied growth variants in equation 9, and add rather than substitute pre-IPO revenue CAGR as a dependent variable equation 9. Similarly, we estimate average long-term abnormal returns by post-IPO revenue CAGR tercile, substitute post-IPO revenue CAGR for implied growth variants in equation 10, and add post-IPO revenue CAGR as a dependent variable in equation 10. For consistency in our regressions, we use variants of realized revenue growth that match the variants of implied expected revenue growth listed earlier. For instance, we complement the test where long-term abnormal returns are regressed on standardized implied expected revenue growth by substituting standardized implied growth for standardized post-IPO revenue growth and by including rather than substituting standardized post-IPO revenue growth.

In regressions involving long-term abnormal returns, we further test the significance of implied expected revenue growth by including firms' average post-IPO EBIT margins and SMB coefficients as dependent variables. We refer to the coefficients from the Fama French time series regressions we use to estimate long-term abnormal returns. Our goal is to account for any effect of profitability on returns that the RMW may not capture, while simultaneously stressing implied growth with an alternative proxy for measuring firm size. Lastly, we test robustness to the inclusion of MKT and HML coefficients. Here, we seek to test robustness to systematic risk and the inclusion of an alternative proxy for growth expectations.

4 Data

4.1 Study Period and Geographic Focus

We select our sample from companies which have gone public from 2012 – 2017 in either the Oslo Stock Exchange or NASDAQ OMX in the Nordics. Two reasons motivate our choice of study period: the desire to collect recent data that is relevant to investors, and limitations in the set of available historical listing records. Our decision to study Nordic companies overall instead of companies from a specific Nordic country helps to address limitations related to historical data by providing for a wider sample base while preserving its homogeneity.

Additional criteria for inclusion in our sample are that firms are still listed by December 31, 2018 (the end of our analysis period) and have enough data to measure their pre-IPO CAGR. These criteria introduce "survivorship bias" in our study, reducing the precision with which we estimate the true size of the high-growth IPO cohort and aggregate measures of firm characteristics, including those related to revenue growth.

4.2 Summary of Data Sources

We obtain IPO listing information from the Oslo Stock Exchange for Norwegian IPOs and from the NASDAQ OMX website for IPOs in Sweden, Denmark, and Finland. Table 1 and Table 2 display historical data on the number of listed companies in each of these exchanges, evidencing an upward trend in the number of firms listed. This highlights the importance of Nordic IPO markets and benefits our sample selection process.

Eikon is our source for historical financial statements as well as for daily and monthly stock price data corresponding to high-growth IPOs and their peers. These data are downloaded in NOK. Our source for inflation estimates and government interest rates is OECD (2020a, b, c). We obtain Fama French 5 factor data from the Kenneth French website and convert into NOK using Eikon FX data. We use monthly 5 factor data for developed countries to estimate peer market betas and levered equity returns, as well as high-growth IPO levered equity returns. We use European 5-factor data to estimate the 1st day and long-term abnormal returns of high-growth IPO firms.

	2019	**2018**	**2017**	**2016**	**2015**	**2014**	**2013**	**2012**
Number of firms	245	238	227	218	209	217	215	225
YoY Change (%)	2.94%	4.85%	4.13%	4.31%	-3.69%	0.93%	-4.44%	-

Table 1: Number of firms listed in the Oslo Stock Exchange at year end, with historical data back to 2012.

Market Segment:	**2019**	**2018**	**2017**	**2016**	**2015**	**2014**	**2013**	**2012**
SWE	333	326	315	294	282	263	251	253
FIN	126	129	125	124	122	119	120	119
DNK	130	133	135	136	143	144	154	162
Total	589	588	575	554	547	526	525	534
First North	351	337	314	252	208	168	131	121
YoY Change, Total (%)	0.17%	2.26%	3.79%	1.28%	3.99%	0.19%	-1.69%	-
YoY Change, First North (%)	4.15%	7.32%	24.60%	21.15%	23.81%	28.24%	8.26%	-

Table 2: Number of firms listed in NASDAQ OMX in the Nordics at year end by country and market segment. We identify countries by their ISO country code. NASDAQ OMX issuances are segmented by country markets and SME growth market v. main market. As of September 1, 2019, First North became the SME growth market for NASDAQ OMX (www.nasdaqomxnordic.com).

4.3 Further Sample Refinements

Our base analysis excludes financial firms. However, we use inclusion of financial firms as a robustness check across our different tests. For those financial high-growth firms which we use in our regressions, we provide revenue growth, valuation, control variable, and abnormal return data in Appendix 4.

In our analysis of underpricing, 1st day abnormal returns, long-term returns, and persistence in revenue growth, we use the 78 non-financial firms which are in the highest tercile of pre-IPO revenue CAGR. At the valuation and regression stage, we follow Cogliati et al. (2011) in excluding the high-growth firms with missing data, a negative EBIT margin, or a negative EBIT-to-FCF conversion ratio on the year prior to IPO. This step is essential to the feasibility of our valuation methodology. A negative EBIT margin or negative EBIT-to-FCF conversion ratio makes linear convergence to positive long-term values for these ratios an impossibility. This decreases our sample size from 78 to 21 companies.

When analyzing 1st day abnormal returns, we also drop Monday IPOs because we are unable to report their abnormal returns in NOK. The reason is that we lack intraday data for FX returns, so we are not able to convert Monday observations of MKT and U.S. 1-month T-bills (the risk free rate proxy) to NOK without violating consistency in using one-day intervals to measure FX returns. In 1st day abnormal return regressions, we drop a total of 5 Monday IPOs: 4 non-financial firms and 1 financial firm.

4.4 Peer Ratios

In this section we compare the distribution of median peer ratios against the assumptions we make in our methodology (Section 3.2.3). Our aim in doing so is to show the degree to which our assumptions agree with or differ from the actual peer distributions. We use 52 unique peers to value our subsample of 24 high-growth IPOs. 2 of those peers correspond to 2 different non-financial high-growth companies, and 9 peers correspond to financial high-growth companies. We focus our discussion on peers for non-financial companies and provide data for financial firm peers in Appendix 4.

As a starting point, we list summary statistics for the ratios of the 43 unique peers in Table 3. We immediately notice that the median peer is profitable, but loses cash, and is a net lender. By construction, the median implied cost of debt is within the boundaries we impose for this variable. Next, we examine the distribution of each variable in greater detail.

VARIABLES	EBIT Margin Mean	D/E Mean	Implied R_d Mean	Winners EBIT-to-FCF Mean	Losers EBIT-to-FCF Mean
N	43.0000	43.0000	26.0000	28.0000	15.0000
mean	-0.9506	-0.1166	0.3112	-1.0366	10.8356
standard dev.	3.4916	0.7102	0.5113	2.2692	12.8115
min	-17.0016	-1.5819	0.0444	-8.0329	-0.7165
max	0.3522	1.5074	2.6263	1.1426	37.3334
variance	12.1913	0.5043	0.2614	5.1493	164.1346
skewness	-4.0574	-0.0759	3.7970	-1.8907	1.0887
kurtosis	18.1897	3.0622	17.5605	5.5466	2.9286
p1	-17.0016	-1.5819	0.0444	-8.0329	-0.7165
p5	-2.5319	-1.5819	0.0464	-6.3582	-0.7165
p10	-2.3956	-1.1827	0.0559	-5.5962	0.8421
p25	-0.3112	-0.4442	0.0981	-1.2332	1.1833
p50	0.0369	-0.1423	0.1290	-0.1519	4.1674
p75	0.1161	0.3299	0.2789	0.2227	18.5255
p90	0.2500	0.7976	0.7087	0.5447	36.9034
p95	0.2787	1.0880	0.8167	0.7467	37.3334
p99	0.3522	1.5074	2.6263	1.1426	37.3334

Table 3: Summary statistics for peer ratios, excluding financial firms. The sample corresponds to the 43 unique peers used to value our subsample of 24 high-growth companies. We calculate peer ratios using average book-value-based measures during the 10-year window prior to the IPO date of the corresponding high-growth firm. Implied R_d refers to implied cost of debt, which we compute for each peer as interest expense divided by the 1-year lag of net debt. Appendix 5 provides further details about the computation of D/E ratios and implied cost of debt. EBIT-to-FCF is equal to peer FCF divided by contemporaneous EBIT. To facilitate interpretation of EBIT-to-FCF, we distinguish between winners – peers with positive average EBIT margins, and losers – peers with negative average EBIT margins.

Our lower boundary assumption of 1% for EBIT margins is not fully consistent with peers' EBIT margin distribution. The median peer has an EBIT margin of 3.7%, but the average peer is unprofitable. Negative skewness partially explains this difference (Table 3), but there are several peers with negative EBIT margins (Figure 1). Still, the assumption of profitability is necessary for our model.

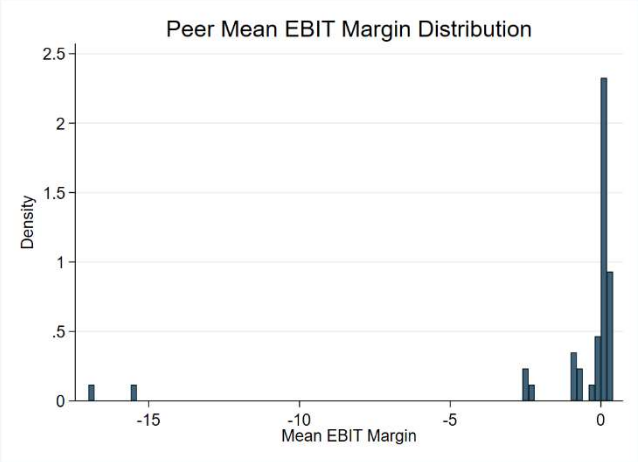


Figure 1: Peer mean EBIT margin distribution, excluding financial firms. We estimate average EBIT margins for each peer over the 10-year window prior to the IPO date of the corresponding high-growth company. The mean of the distribution is -0.9506, while the median is 0.0369. A skewness of -4.0084 partially explains this difference.

To facilitate the interpretation of EBIT-to-FCF ratios, we distinguish between winners – companies with a positive average EBIT margin (Figure 2) – and losers – companies with an average EBIT margin less than or equal to 0 (Figure 3). The distribution of average EBIT-to-FCF ratios contradicts our lower boundary assumption of 1 percent. 15 out of 43 firms are losers, and most of these make negative FCF. Moreover, the median loser has an EBIT-to-FCF of 4.1674 (Table 3). The economic interpretation of this measure poses a challenge. We propose the following alternative explanations: (1) high depreciation levels, (2) large capital expenditures, or (3) highly negative values of change in net working capital. Concerning winners, the median firm has an EBIT-to-FCF of -0.1519, and the distribution is negatively skewed (Table 3). In contrast to our lower boundary assumption for EBIT-to-FCF, our upper boundary assumption of 1 minus the applicable statutory corporate tax rate is consistent with the observed distribution.

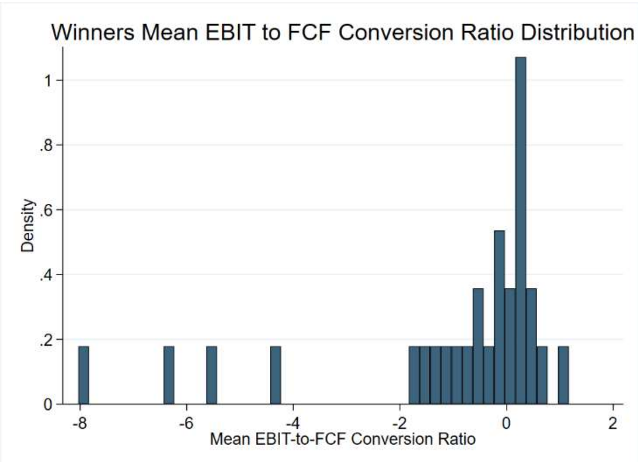


Figure 2: Winners' mean EBIT-to-FCF conversion ratio distribution, excluding financial firms. We estimate EBIT-to-FCF means for each peer over the 10-year window prior to the IPO date of the corresponding high-growth company. Since we observe negative skewness, we propose focusing on the median.

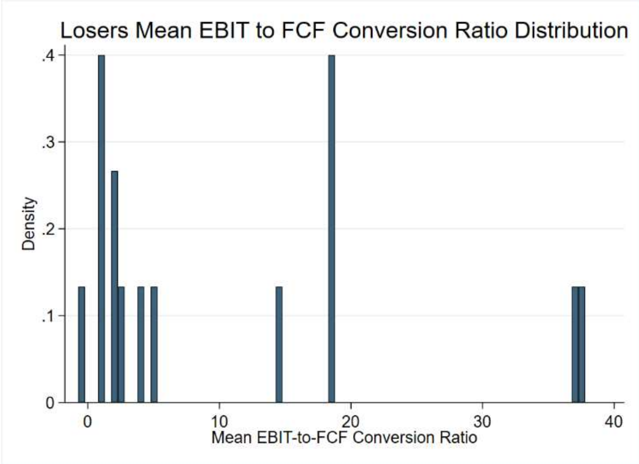


Figure 3: Losers mean EBIT-to-FCF conversion ratio distribution, excluding financial firms. We estimate EBIT-to-FCF means for each peer over the 10-year window prior to the IPO date of the corresponding high-growth company. We observe consistency in the performance of losers, i.e., they mostly remain losers, with several cases of extreme values.

Our lower boundary of 0 on D/E for high-growth IPO contradicts the distribution of average historical D/E for peers (Figure 4). The median peer is a net lender, with an average D/E ratio of –0.1423. This may due to imprecise estimates for average D/E. Peer data is not always available for the full 10-year period prior to the IPO date of the corresponding high-growth company, because the high-growth firms in our sample often operate with new products and breakthrough technologies. In addition, we deem it economically unreasonable to assume that (non-financial) high-growth IPO companies will be net lenders within our valuation horizon of 10 years.

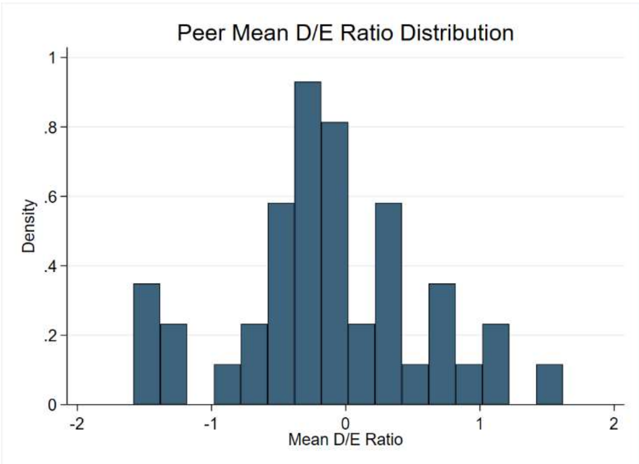


Figure 4: Peer mean D/E ratio distribution, excluding financial firms. We estimate D/E means for each peer over the 10-year window prior to the IPO date of the corresponding high-growth company. Appendix 5 provides further details about the computation of annual D/E ratios. We observe low negative skewness and a negative mean and median.

Figure 5 shows the distribution of average historical implied cost of debt. The largest peer groups had an implied cost of debt lower than 20%. This motivates our upper boundary assumption for the implied cost of debt in high-growth IPO valuations.

We acknowledge the presence of outliers in the implied cost of debt distribution. This may be due either to the limitations of our estimator or to the lack of sufficient historical financial statement data for some peers. This is despite the restriction we apply to use only peers which have gone public at least 5 years prior to the IPO date of the corresponding high-growth firm.

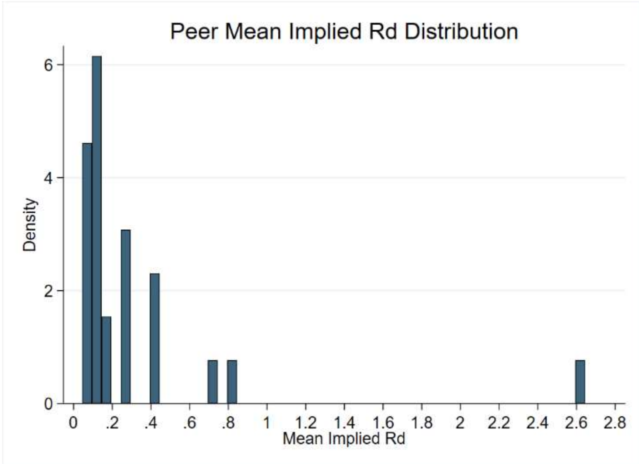


Figure 5: Peer mean implied cost of debt distribution, excluding financial firms. We estimate mean implied cost of debt for each peer over the 10-year window prior to the IPO date of the corresponding high-growth company. We estimate annual implied cost of debt observations as interest expense divided by the lag of net debt, with further details provided in Appendix 5. The median of the distribution is 0.1290, and skewness is 3.7970.

4.5 International Interest Rates

We now analyze the spread of interest rates across countries in our sample (including peers' countries of origin) to get a sense of how much estimation error may be introduced in our model due to use of a single proxy for the risk-free rate. Given our chosen data sources (Section 4.2), the US 1-month T-bill rate is our proxy for estimating peers' levered and unlevered equity returns, as well as high-growth IPOs' WACC and abnormal returns (both 1st day and long-term).

We also analyze country spreads for 10-year government bond rates because we use these to establish a lower boundary on cost of debt assumptions for high-growth IPOs. We set the boundary as the maximum of 2 percent and the contemporaneous annual observation of the equal-weighted average 10-year government bond rate across Nordic countries.

4.5.1 Short-term Interest Rates

As shown on in Table 4 and Figure 6, short-term rates vary widely across developed countries in our sample. However, the issue has diminished over time, and it has historically been less severe for Nordic countries. As mentioned earlier, we recognize the trade-off we make between precision and model tractability.

ISO country code	Mean	Standard dev.	Max	p99	p95	Median	p5	p1	Min
CHE	2.8743	2.8830	10.1652	10.1652	8.9180	2.4835	(0.7341)	(0.7838)	(0.7838)
DEU	4.6355	3.0002	12.1425	12.1425	9.9025	4.2776	(0.2637)	(0.3291)	(0.3291)
DNK	4.3202	3.7153	11.6912	11.6912	11.0506	3.6374	(0.2642)	(0.2983)	(0.2983)
FIN	4.3510	4.3210	13.9967	13.9967	13.2517	3.2751	(0.3221)	(0.3291)	(0.3291)
FRA	6.0235	4.3144	15.2592	15.2592	13.0192	5.8467	(0.2637)	(0.3291)	(0.3291)
GBR	5.3620	4.0738	14.8090	14.8090	13.9318	5.5114	0.4990	0.3590	0.3590
JPN	0.2889	0.2459	0.8467	0.8467	0.8467	0.2208	0.0593	0.0593	0.0593
NLD	3.7921	2.8215	9.3525	9.3525	9.2817	3.4550	(0.3221)	(0.3291)	(0.3291)
NOR	6.9767	4.6983	15.3667	15.3667	14.5521	6.0346	1.0667	0.8900	0.8900
SWE	5.4844	4.7889	14.1742	14.1742	13.6675	4.0327	(0.6858)	(0.6950)	(0.6950)
USA	5.3833	3.5896	15.9108	15.9108	12.2708	5.3600	0.2267	0.1242	0.1242

Table 4: Summary statistics for short-term government interest rates. We report the rates in percent per annum. The 11 countries listed by ISO country code include the countries of origin for the peers which correspond to our sample of high-growth IPOs. We include countries of origin for peers corresponding to financial companies. We obtain the data we use for the development of this table from the OECD website (2020b).

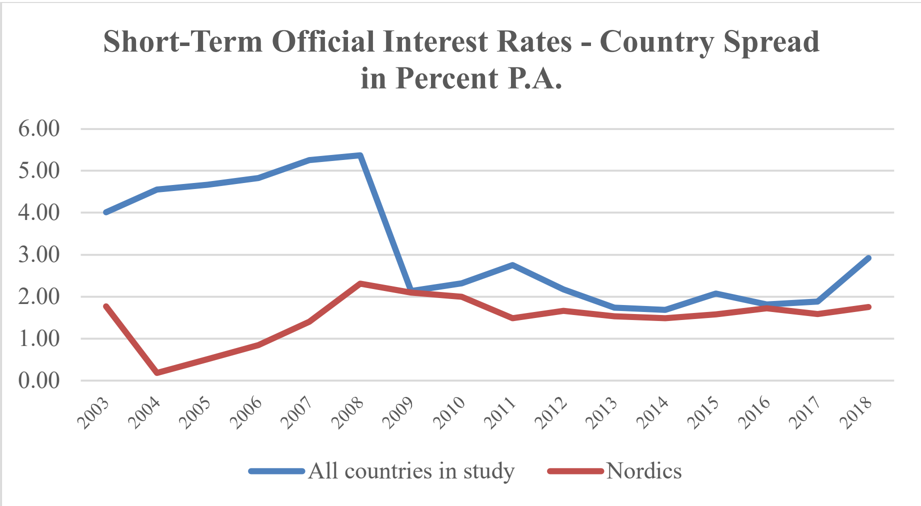


Figure 6: Historical spread in short-term interest rates across all countries in our study and the Nordics, in percent per annum. We analyze the period 2003 – 2018. For the list of countries included, see Table 4 or Section 3.2.2. We calculate spreads annually as the cross-sectional maximum less the cross-sectional minimum. We download the data that we use for the development of this plot from the OECD website (2020b).

4.5.2 10-year Government Bond Rates

We use OECD long-term government rates (2020c) to compute a time-series of the equal-weighted average 10-year government bond rate across the Nordics (Figure 8). The annual average corresponding to each IPO year functions as a lower bound for cost of debt estimates in valuations (Section 3.2.3). As with short-term rates, we observe large spreads across all countries in our study, but lower spreads historically for the Nordics (Table 5; Figure 7). This suggests that our use of average Nordic rates to bound cost of debt estimates introduces less error in our model compared to our use of the US 1-month T-bill rate as a risk-free rate proxy.

ISO_country_code	Mean	Standard_dev.	Max	p99	p95	Median	p5	p1	Min
CHE	3.6118	1.6779	7.1292	7.1292	6.3984	3.7963	0.0332	(0.3620)	(0.3620)
DEU	5.8365	2.5090	10.4417	10.4417	8.9083	6.3375	0.4958	0.0900	0.0900
DNK	5.0759	3.2023	11.2844	11.2844	10.6287	4.6125	0.4558	0.3208	0.3208
FIN	5.3370	3.7256	13.2100	13.2100	12.0858	4.2933	0.5467	0.3650	0.3650
FRA	6.9705	3.7628	16.2917	16.2917	14.3683	6.5792	0.8105	0.4679	0.4679
GBR	7.4585	3.6848	14.8833	14.8833	13.9133	7.0526	1.4607	1.2358	1.2358
JPN	2.1242	1.8887	6.9599	6.9599	6.3367	1.4800	0.0517	(0.0663)	(0.0663)
NLD	5.7973	2.6249	11.5525	11.5525	9.9608	6.2342	0.6335	0.2911	0.2911
NOR	6.1293	3.6223	13.3050	13.3050	13.2992	5.4488	1.5650	1.3317	1.3317
SWE	5.5524	3.7525	13.1592	13.1592	11.6800	4.8092	0.6517	0.5192	0.5192
USA	5.8539	2.8323	13.9108	13.9108	11.4600	5.2642	2.3300	1.8025	1.8025

Table 5: Summary statistics for 10-year government bond rates. We report rates in percent per annum. The 11 countries listed by ISO country code include the countries of origin for the peers which correspond to our sample of high-growth IPOs. We include countries of origin for peers corresponding to financial companies. We download the data that we use for the development of this table from the OECD website (2020c).

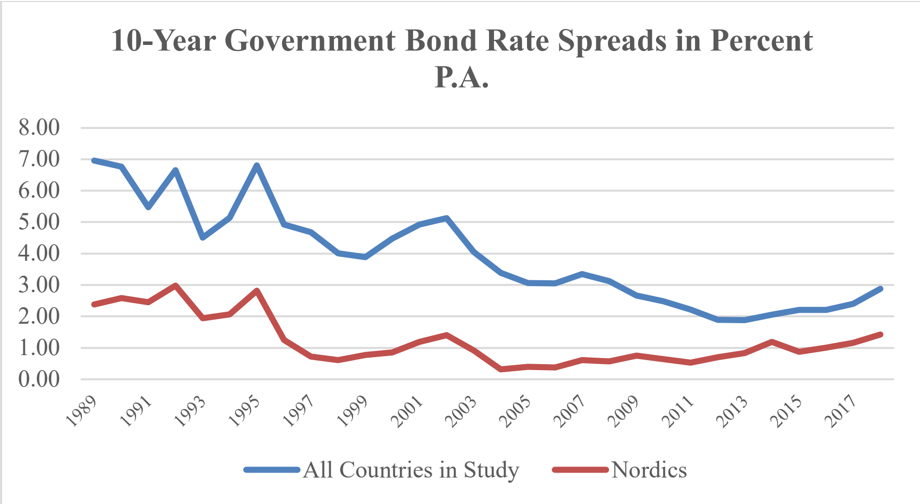


Figure 7: Historical spread in 10-year government bond rates across all countries in our study and the Nordics, in percent per annum. We analyze the period 1989 – 2018. For the list of countries included, see Table 5 or Section 3.2.2. We calculate spreads annually as the cross-sectional maximum less the cross-sectional minimum. We download the data that we use for the development of this plot from the OECD website (2020c).

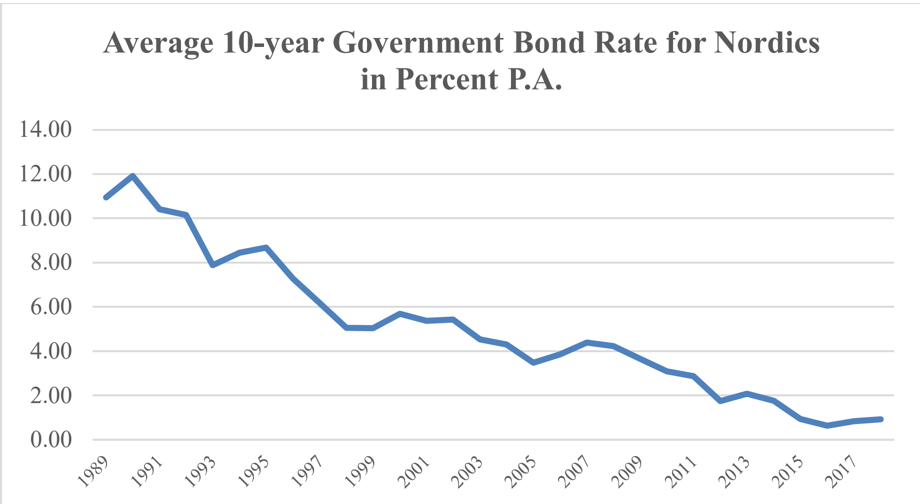


Figure 8: Equal-weighted average 10-year government bond rate across Nordic countries. We report the series in percent per annum. We use this series in our study to set a lower boundary for estimates of cost of debt we use in IPO valuations, as we describe in Section 3.2.3. We download the data that we use for the development of this plot from the OECD website (2020c).

4.6 Descriptive Statistics for Growth and Controls

As a preamble to our main analysis, we provide summary statistics for growth variables (Table 6) and the control variables used in our 1st day abnormal return regressions (Table 7). Pre-IPO revenue growth exhibits remarkable levels upwards of the median of the distribution. Post-IPO revenue growth is more moderate, as are our derived measures of implied expected revenue growth. Still, a kurtosis above 3 in the distribution of both post-IPO revenue growth and pre-IPO revenue growth informs us that these variables exhibit a high frequency of extreme observations. For this reason, we winsorize these variables at the 10th and 90th percentiles in our regressions; and for consistency, we winsorize implied growth at the same cutoffs. In addition, these statistics reinforce our expectation that post-IPO revenue growth underperforms expectations at the time of IPO (Hypothesis 3), while they diminish the expectation of persistence in revenue growth (Hypothesis 4).

Regarding the control variables in 1st day abnormal return regressions (Table 7), log B/M ratios are largely consistent with the high-growth categorization of our sample, although positive values for this variable are observed from the 90th percentile. Log sales as a proxy for size indicates dispersion along this dimension in our sample. EBIT margins also exhibit dispersion. This variable's standard deviation exceeds its mean, and its kurtosis is over twice that of the normal distribution.

VARIABLES	Implied Growth	Post-IPO Revenue CAGR	Pre-IPO Revenue CAGR
N	21.0000	21.0000	21.0000
mean	0.5742	0.3929	1.5911
standard dev.	0.3335	0.5184	2.7881
min	-0.0039	-0.0278	0.3182
max	1.2352	2.0004	13.3683
variance	0.1112	0.2688	7.7734
skewness	0.2332	2.0174	3.8223
kurtosis	2.3896	6.2770	16.7350
p1	-0.0039	-0.0278	0.3182
p5	0.0969	0.0018	0.3200
p10	0.1995	0.0283	0.3200
p25	0.3340	0.1009	0.3730
p50	0.5213	0.2202	1.0049
p75	0.8575	0.4365	1.5400
p90	0.9080	0.9611	2.0590
p95	1.1719	1.5391	2.6063
p99	1.2352	2.0004	13.3683

Table 6: Summary statistics for growth variables, excluding financial firms. We estimate implied growth as the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). We measure post-IPO revenue CAGR from the fiscal year prior to IPO until 2018. Pre-IPO revenue CAGR corresponds to the 5-year window prior to each IPO date. N records the number of observations and the prefix "p" indicates percentiles of the distribution.

VARIABLES	Ln(B/M)	Ln(Sales)	EBIT Margin
N	21.0000	21.0000	21.0000
mean	-1.6378	12.8532	0.1526
standard dev.	1.4285	2.1845	0.1666
min	-3.5855	8.9651	0.0349
max	0.8736	17.1848	0.6794
variance	2.0407	4.7721	0.0278
skewness	0.2071	0.2675	2.3550
kurtosis	1.6826	2.1209	7.4469
p1	-3.5855	8.9651	0.0349
p5	-3.5289	10.0526	0.0385
p10	-3.4297	10.7082	0.0387
p25	-2.6836	11.4645	0.0683
p50	-1.9642	12.3922	0.0995
p75	-0.1411	14.6756	0.1319
p90	0.0113	15.8308	0.2182
p95	0.4099	15.8525	0.5738
p99	0.8736	17.1848	0.6794

Table 7: Summary statistics for control variables used in 1st day abnormal return regressions, excluding financial firms. We measure Ln(B/M) as total common book equity in the year prior to IPO, divided by market capitalization at 1st day close (Appendix 5 provides further details about the computation of this variable). We measure EBIT margin in the fiscal year prior to IPO. Ln(Sales) is the natural log of sales in the year prior to IPO. N records the number of observations and the prefix "p" indicates percentiles of the distribution.

4.7 Correlation Structure of Regression Variables

We also analyze the correlations between the different variables in our model, with the variables of chief interest being implied expected revenue growth, annualized long-term abnormal returns, and 1st day abnormal returns. In Table 8, implied growth exhibits the highest and lowest correlations to annualized long-term abnormal returns and 1st day abnormal returns, respectively. Annualized long-term returns have an even stronger correlation to pre-IPO revenue growth, but our view is that this relationship is of little economic interest. For 1st day abnormal returns, ignoring mechanical or temporally mismatched relationships, the largest coefficient is that with implied expected revenue growth. The relative magnitude of correlations is consistent with what we expected, but the signs on the implied growth correlations are contrary to our initial expectation.

There is more to the story in Table 9. Implied growth, annualized long-term abnormal returns and 1st day abnormal returns all have relatively large correlations with average post-IPO EBIT-to-FCF (relative to the coefficients in Table 8). Implied growth also has relatively strong correlations with pre-IPO EBIT-to-FCF, pre-IPO log sales, and log B/M. The first of these correlations indicates the need to observe relationships between implied growth and other valuation variables as context for abnormal return - implied growth relationships. We address the latter two correlations by including pre-IPO log sales and log B/M as control variables in 1st day abnormal return regressions. We also notice that annualized long-term abnormal return has relatively strong correlations with pre-IPO EBIT margins and pre-IPO log sales, justifying our intent to test for the robustness of the abnormal return - implied growth relationship to profitability and size. Lastly, 1st day abnormal returns also display a relatively strong correlation with pre-IPO EBIT margins. We address this fact by including pre-IPO EBIT margin as a control variable in 1st day abnormal return regressions.

It is worth mentioning that pre-IPO growth has a low correlation with post-IPO growth, implying that our sample does not exhibit the revenue growth persistence phenomenon found in previous papers (Chan et al., 2003; Hall et al., 2008). We close this subsection with the key conclusion that Table 8 and Table 9 give us no evidence that a mechanical relationship drives our measure of implied expected revenue growth.

	Implied Growth	Pre-IPO Growth	Post-IPO Growth	Annualized Long-Term Abnormal Returns	1st Day Abnormal Return	Underpricing	Offer Price	1st Day Close	β_{MKT}	β_{SMB}	β_{HML}	β_{RMW}
Implied Growth	1.00	0.22	0.24	0.40	-0.32	-0.25	-0.10	-0.12	0.10	0.03	0.10	0.04
Pre-IPO Growth	0.22	1.00	0.51	0.43	0.06	-0.01	0.22	0.23	0.17	-0.18	0.21	0.09
Post-IPO Growth	0.24	0.51	1.00	0.16	0.37	0.40	-0.19	-0.15	0.49	-0.47	0.53	0.25
Annualized Long-Term Abnormal Returns	0.40	0.43	0.16	1.00	0.06	0.02	0.27	0.28	0.34	-0.11	0.19	-0.10
1st Day Abnormal Return	-0.32	0.06	0.37	0.06	1.00	0.99	-0.22	-0.09	0.43	-0.41	0.26	-0.01
Underpricing	-0.25	-0.01	0.40	0.02	0.99	1.00	-0.22	-0.11	0.35	-0.32	0.18	-0.01
Offer Price	-0.10	0.22	-0.19	0.27	-0.22	-0.22	1.00	0.99	-0.14	0.13	-0.14	0.01
1st Day Close	-0.12	0.23	-0.15	0.28	-0.09	-0.11	0.99	1.00	-0.10	0.09	-0.13	0.00
β_{MKT}	0.10	0.17	0.49	0.34	0.43	0.35	-0.14	-0.10	1.00	-0.86	0.90	0.24
β_{SMB}	0.03	-0.18	-0.47	-0.11	-0.41	-0.32	0.13	0.09	-0.86	1.00	-0.83	-0.55
β_{HML}	0.10	0.21	0.53	0.19	0.26	0.18	-0.14	-0.13	0.90	-0.83	1.00	0.13
β_{RMW}	0.04	0.09	0.25	-0.10	-0.01	-0.01	0.01	0.00	0.24	-0.55	0.13	1.00

Table 8: Correlations between revenue growth and abnormal return variables and parameters, excluding financial firms. We estimate implied growth as the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). Pre-IPO revenue CAGR corresponds to the 5-year window prior to each IPO date. We measure post-IPO revenue CAGR from the fiscal year prior to IPO until 2018. We estimate long-term abnormal returns as the annualized Fama French intercept for each firm (see Section 3.5). β_{MKT}, β_{SMB}, β_{HML}, and β_{RMW} are the slope coefficients from our Fama French regressions. We estimate 1st day abnormal returns as the 1st day return of each IPO, net of the market and risk-free rate returns at the date of IPO, using daily Fama French European 5 Factor data from the Kenneth French website. Underpricing is the intraday return on IPO day. Offer Price and 1st day close are the intraday price observations for each IPO.

	Implied Growth	Annualized Long-Term Abnormal Returns	1st Day Abnormal Return	Log B/M	Pre-IPO EBIT Margin	Pre-IPO EBIT-to-FCF	Pre-IPO Log Sales	Post-IPO Average EBIT Margin	Post-IPO EBIT-to-FCF (Winners)	Post-IPO EBIT-to-FCF (Losers)
Implied Growth	1.00	0.40	-0.32	-0.63	-0.03	-0.30	-0.48	-0.15	-0.39	0.56
Annualized Long-Term Abnormal Returns	0.40	1.00	0.06	-0.36	0.40	0.05	-0.38	0.09	-0.41	-0.62
1st Day Abnormal Return	-0.32	0.06	1.00	-0.16	0.46	0.11	-0.05	0.37	-0.49	-0.38
Log B/M	-0.63	-0.36	-0.16	1.00	-0.37	0.15	0.61	-0.08	0.59	-0.04
Pre-IPO EBIT Margin	-0.03	0.40	0.46	-0.37	1.00	0.16	-0.33	0.71	-0.55	-0.69
Pre-IPO EBIT-to-FCF	-0.30	0.05	0.11	0.15	0.16	1.00	-0.35	-0.08	-0.11	-0.54
Pre-IPO Log Sales	-0.48	-0.38	-0.05	0.61	-0.33	-0.35	1.00	0.09	0.42	0.92
Post-IPO Average EBIT Margin	-0.15	0.09	0.37	-0.08	0.71	-0.08	0.09	1.00	-0.64	0.25
Post-IPO EBIT-to-FCF (Winners)	-0.39	-0.41	-0.49	0.59	-0.55	-0.11	0.42	-0.64	1.00	
Post-IPO EBIT-to-FCF (Losers)	0.56	-0.62	-0.38	-0.04	-0.69	-0.54	0.92	0.25		1.00

Table 9: Correlations between revenue growth, abnormal return variables, and control variables, excluding financial firms. Implied growth is the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). We estimate long-term abnormal returns as the annualized Fama French intercept for each firm (see Section 3.5). 1st day abnormal returns are equal to the 1st day return of each IPO, net of the market and risk-free rate returns at the date of IPO, using daily Fama French European 5 Factor data from the Kenneth French website. We measure Log(B/M) as the natural log of total common book equity in the year prior to IPO, divided by market capitalization at 1st day close (further details about the computation of this variable are found in Appendix 5). We report pre-IPO variables as of the fiscal year prior to each IPO. EBIT-to-FCF is equal to FCF divided by EBIT, and log sales are based on the natural logarithm. We measure post-IPO variables as historical averages for each IPO firm, from the year of IPO until 2018. The “winners” and “losers” labels denote companies which had positive average EBIT margin and average EBIT margin less than or equal to zero, respectively. We make this distinction to facilitate the interpretation of EBIT-to-FCF ratios.

5 Results

5.1 Underpricing and Long-Term Abnormal Returns

We observe no statistical significance for underpricing, 1st day abnormal returns nor long-term abnormal returns, unless we winzorize. Moreover, the sign of the means of all these variables is opposite to that in previous research. The presence of skewness (although small in the case of underpricing) suggests that medians are a more reliable measure, but these do not align with prior research either. These results remain the same when including financial firms. Summary statistics for the referred variables are reported in Table 10. Also, histograms after winsorization at the 10th and 90th percentiles are shown in Figure 9-Figure 10.

We take these findings with a grain of salt, noting that we obtain quite high standard deviations relative to the absolute value of the variable means. This may be due to either a small size of our sample or extreme values because of market uncertainty about the true value of high-growth IPO firms. However, we do not discard the possibility that these results are evidence that high-growth firms are different from IPOs overall.

VARIABLES	**Annualized Long-Term Abnormal Returns**	**1st Day Abnormal Returns**	**Underpricing**	**Annualized Long-Term Abnormal Returns (Winsorized)**	**1st Day Abnormal Returns (Winsorized)**	**Underpricing (Winsozrized)**
N	78	64	78	78	64	78
mean	21.0293	-0.0232	-0.0189	0.1697**	-0.0203**	-0.0208**
t-statistic(mean)	1.4989	-1.5931	-1.3386	2.6156	-2.1284	-2.2403
p-value(t-stat)	0.1380	0.1161	0.1846	0.0107	0.0372	0.0280
standard dev.	123.9063	0.1165	0.1247	0.5730	0.0763	0.0820
min	-0.7874	-0.5568	-0.5696	-0.4690	-0.1505	-0.1623
max	987.0530	0.2746	0.3791	1.4540	0.0877	0.1057
variance	15,352.7758	0.0136	0.0156	0.3284	0.0058	0.0067
skewness	6.8121	-1.3580	-0.5512	1.0918	-0.2334	-0.1656
kurtosis	50.8113	8.9712	7.8832	3.2696	2.0180	2.1124
p1	-0.7874	-0.5568	-0.5696	-0.4690	-0.1505	-0.1623
p5	-0.6202	-0.1649	-0.1844	-0.4690	-0.1505	-0.1623
p10	-0.4690	-0.1505	-0.1623	-0.4690	-0.1505	-0.1623
p25	-0.2327	-0.0718	-0.0736	-0.2327	-0.0718	-0.0736
p50	0.0247	-0.0130	-0.0145	0.0247	-0.0130	-0.0145
p75	0.2978	0.0449	0.0476	0.2978	0.0449	0.0476
p90	1.4540	0.0877	0.1057	1.4540	0.0877	0.1057
p95	14.7638	0.1354	0.1934	1.4540	0.0877	0.1057
p99	987.0530	0.2746	0.3791	1.4540	0.0877	0.1057

Table 10: Summary Statistics for abnormal return variables, excluding financial firms. Winsorization is at the 10th and 90th percentiles. ** indicates statistical significance at the 5 percent level. We estimate long-term abnormal returns as the annualized Fama French intercept for each firm (see Section 3.5). 1st day abnormal returns are equal to 1st day returns net of the market factor and risk-free rate observations for that day, using daily Fama French European 5 factor data. Underpricing is the intraday return on the date of IPO. N records the number of observations and the prefix "p" indicates percentiles of the distribution. For 1st day abnormal returns, we exclude Monday IPOs, as we explain in Section 4.3.

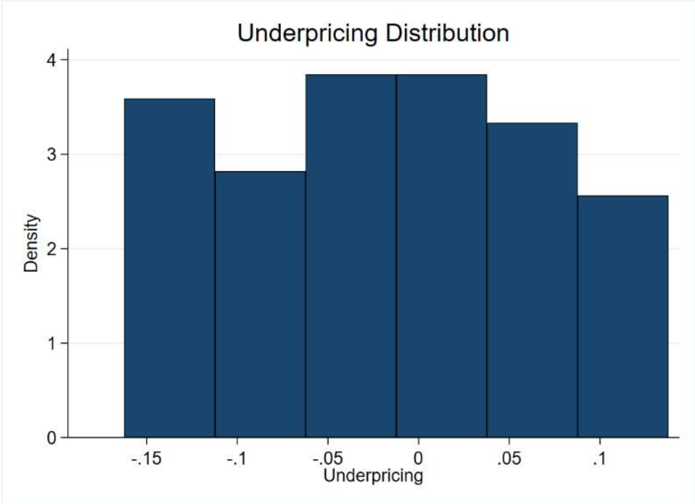


Figure 9: Underpricing distribution after winsorization at the 10th and 90th percentiles, excluding financial firms. We measure underpricing as the intraday return on IPO day.

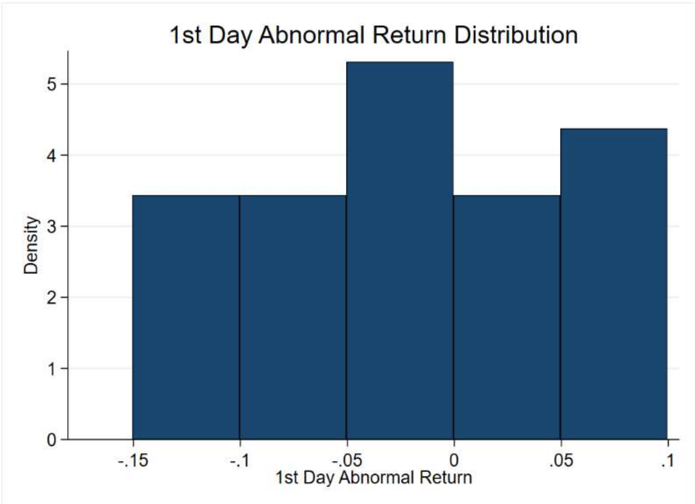


Figure 10: 1st day abnormal returns distribution after winsorization at the 10th and 90th percentiles, excluding financial firms. 1st day abnormal returns are equal to 1st day returns net of the market factor and risk-free rate observations for that day, using daily Fama French European 5 factor data

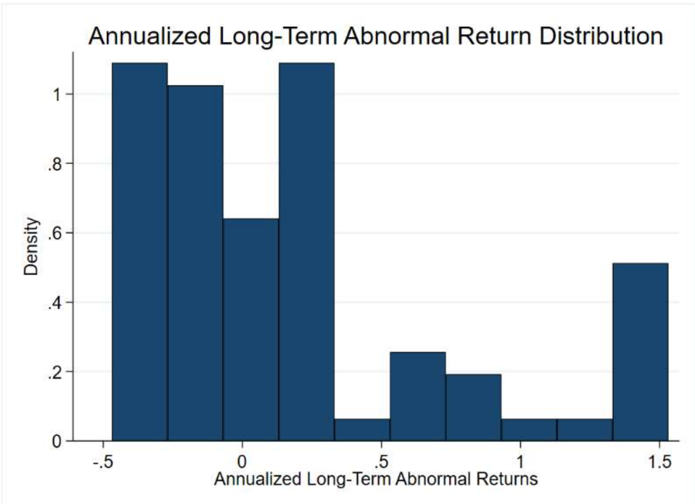


Figure 11: Annualized long-term abnormal return distribution after winsorization at the 10th and 90th percentiles, excluding financial firms. We estimate long-term abnormal returns as the annualized Fama French intercept for each firm (see Section 3.5).

5.2 Assessment of the Quality of Valuation Assumptions

Prior to viewing the remainder of our main results, it is useful to assess any systematic failures in our valuation assumptions, because of their potential impact on the rest of our study. Table 11 shows the result of cross-sectional regressions of realized measures for key valuation variables on our assumptions for those variables, and of testing the null hypothesis that the realizations are equal to our assumptions (i.e., that the intercept of the regression is 0 and the slope is equal to 1). On average, with a 5 percent level of significance, we hit the mark. This result is robust to the inclusion of financial firms. Assuming that the market's expectations are on average realized, this tells us that (1) our assumptions are reasonable proxies for market expectations at the time of IPO, and (2) our selection of peers to derive our assumptions was accurate.

We qualify these statements with regard to the tests for EBIT-to-FCF ratios and implied cost of debt. Our test for EBIT-to-FCF measures the divergence of our assumption from average post-IPO realized measures, provided that average post-IPO EBIT margins were positive. The reason for this is that the interpretation of EBIT-to-FCF changes depending on the sign of the EBIT margin, and our valuation assumptions include positive long-term EBIT margins for all high-growth firms (note that we fail to reject that our assumptions for EBIT margins are correct). As for the test on implied cost of debt, we measure the preciseness of our assumptions provided that firms actually became borrowers. This is because our estimator for implied cost of debt only captures estimates for firms that become borrowers.

Variables	Alpha	Beta	F-stat	p-value (F-stat)	N
Revenue growth	0.5753	0.0625	0.8766	0.3609	21
EBIT Margin	0.5994	0.0136	0.9470	0.3427	21
EBIT-to-FCF Conversion Ratio	-6.4650	2.2155	3.4023	0.0899	14
D/E Ratio	0.1877	0.0888	2.0841	0.1651	21
Implied Cost of Debt	-0.3958	0.2146	2.4896	0.1429	13

Table 11: Results of cross-sectional regressions of realized measures on valuation assumptions, excluding financial firms. Realized measures are arithmetic historical averages from the fiscal year of IPO up to 2018. The only exception is revenue growth, which is a geometric mean. We assess the realized EBIT-to-FCF ratio only for firms with positive realizations of average post-IPO EBIT margin, since our assumption is that all IPO firms will be profitable and have positive FCF. We measure implied cost of debt as explained in Section 3.2. 8 firms do not have measurable implied cost of debt according to our methodology and are therefore dropped in the corresponding regression. We provide further details on the computation of D/E ratios and implied cost of debt estimates in Appendix 5. N records the number of observations used in each regression. We use White's heteroscedasticity robust standard errors. The null hypothesis of the F-tests performed is that the alpha or intercept is equal to zero and the beta or slope coefficient is equal to one. These results show that on average, our assumptions match with post-IPO realizations.

The relationship between post-IPO growth and implied expected revenue growth also warrants additional attention. Figure 12 shows this by delineating in red the relationship we would observe if post-IPO revenue growth were equal to implied expected revenue growth at the time of IPO, while displaying a scatter plot for the actual observed relationship. Although statistically this relationship is identical to the one show in the red line, individual observations exhibit a more interesting pattern, which is reminiscent of venture capital investment portfolios. A few outperformers balance out a greater number of underperformers, which on average balances out the portfolio. We also notice that most of these outperformers have lower values of implied growth.

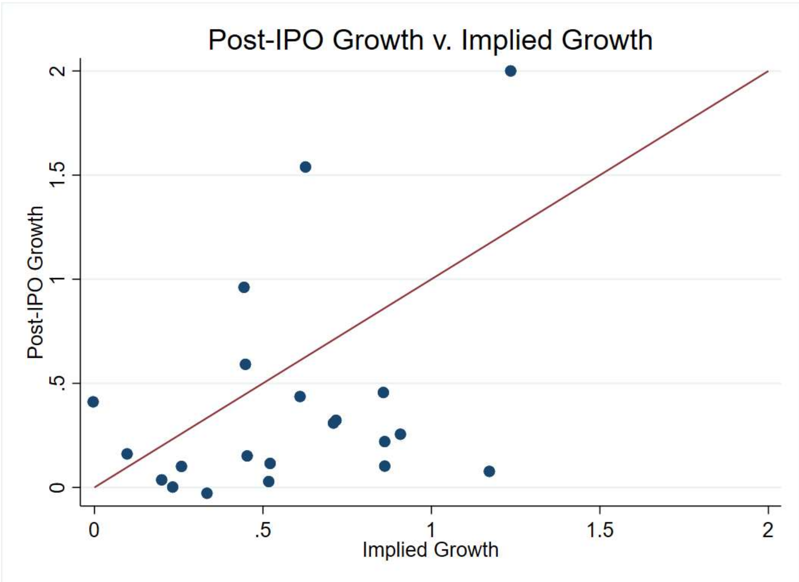


Figure 12: Comparison of post-IPO revenue CAGRs against implied expected revenue growth at the time of IPO, excluding financial firms. We measure post-IPO growth from the fiscal year prior to IPO until 2018. Implied growth is the rate which satisfies the offer price, based on the valuation methodology detailed in Section 3.2. We delineate in red the relationship that would be observed if post-IPO revenue growth were exactly equal to implied expected revenue growth at the time of IPO.

We also give special attention to the persistence of revenue growth. This is not an assumption in our model. However, it could be considered a widespread assumption based on evidence of extrapolation (Lakonishok et al., 1994), and it conforms one of our hypotheses, given the evidence for the phenomenon (Chan et al., 2003; Hall et al., 2008). Figure 13 proves visually and statistically that on average, revenue growth rates decline post-IPO for Nordic high-growth IPOs. This result is robust to the inclusion of financial firms. Notably, the few firms which improve their growth performance post-IPO are concentrated in the group with lower pre-IPO revenue CAGRs.

The main reason why our results differ from prior research is likely that we use a different test for persistence[5]. Nonetheless, we do not dismiss this as possible evidence that revenue growth persistence is different for high-growth IPOs compared to firms in general.

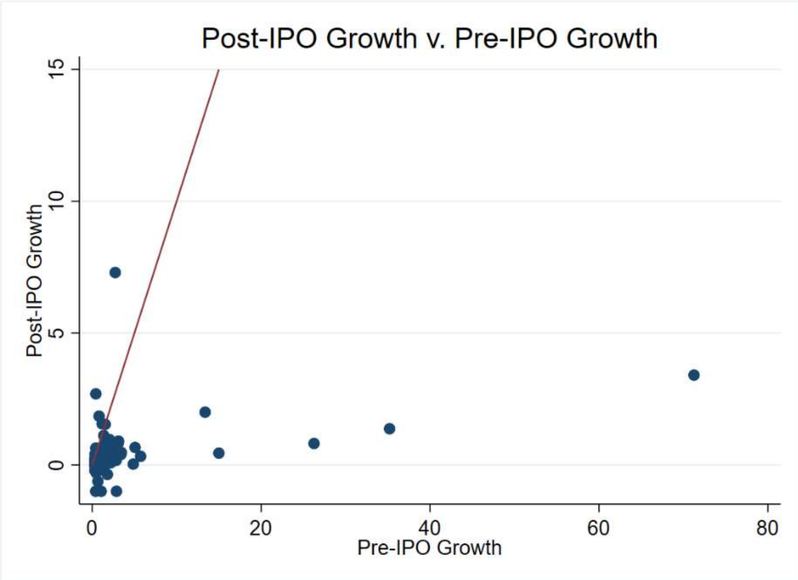


Figure 13: Comparison of post-IPO revenue CAGRs against pre-IPO revenue CAGRs, excluding financial firms. We analyze all 78 non-financial high-growth firms in our sample. We measure post-IPO growth from the fiscal year prior to IPO until 2018, and measure pre-IPO revenue CAGR during the five-year window ending the fiscal year prior to IPO. The red line depicts the relationship that would be observed if post-IPO growth were equal to pre-IPO growth. We further analyze that relationship by regressing post-IPO growth on pre-IPO growth and testing the null hypothesis that the constant is equal to 0 and the slope is equal to 1. We estimate this regression using White's heteroscedasticity robust standard errors. The F-statistic for the test of the null hypothesis is 49,994.51 and has a p-value of 0.0000. Our evidence indicates no persistence of revenue growth in the post-IPO period for Nordic high-growth firms.

5.3 Distributional Relation Between Returns and Growth

5.3.1 1st Day Abnormal Returns and Growth

We now turn to the main question of our research: the relationship between growth and returns for high-growth Nordic IPOs. Unless otherwise indicated, our analysis from this section onward is based on winsorized versions of implied expected revenue growth, pre-IPO revenue CAGR, post-IPO revenue CAGR, 1st day abnormal returns, underpricing, and long-term annualized abnormal returns. Cutoffs are at the 10th and 90th percentiles. Figure 14 shows that 1st day abnormal returns are weakly monotonically decreasing in implied growth. This suggests that the relationship we will observe between implied growth and 1st day abnormal returns will contradict our initial expectation and the results which Cogliati et al. document for Western European markets (2011).

[5] Chan et al. (2003) and Hall et al. (2008) report persistence in growth when the percentage of companies which achieve above-median growth for 5 consecutive years exceeds what chance would dictate.

While we examine the relationship between 1st day abnormal returns and implied growth more rigorously at the regressions stage, we now consider the possibility that variability in offer prices may mechanically drive this relationship. Holding all else constant, higher offer prices could elicit both higher implied growth estimates and lower expected returns. However, the negative correlation between implied expected revenue growth and offer prices provides evidence against a mechanical relationship (Table 8).

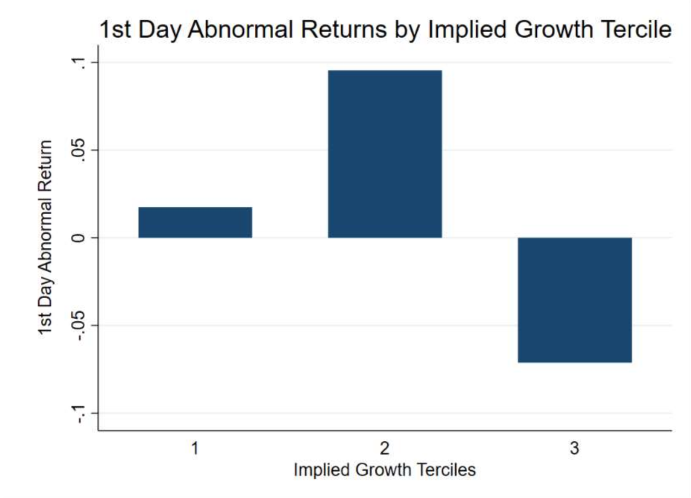


Figure 14: Average 1st day abnormal returns by cross-sectional implied growth terciles, excluding financial firms. 1st day abnormal returns are equal to 1st day returns net of the market factor and risk-free rate observations for that day, using daily Fama French European 5 factor data. As elsewhere in our thesis, implied growth is the revenue growth rate which satisfies the offer price, based on the valuation methodology detailed in Section 3.2. We winsorize both variables at the 10th and 90th percentiles.

The fact that IPO firm's EBIT margins and EBIT-to-FCF conversion ratios are both decreasing in implied growth (Figure 15 – Figure 16) suggests that these ratios might explain the pattern of 1st day abnormal returns against implied growth. However, as with offer prices, the correlations among EBIT margins, EBIT-to-FCF and implied growth do not present convincing evidence for that idea.

Rather, we offer the interpretation that revenue growth expectations – which we proxy with implied growth – justify high-growth IPOs' offer prices when their EBIT margins and EBIT-to-FCF are low. This is consistent with Kim and Ritter (1999). Under our proposed view, the pattern of 1st day abnormal returns against implied growth is evidence of a short-term efficient, rational adjustment by risk-averse investors against over-optimistic growth assumptions associated to riskiness from low EBIT margins and EBIT-to-FCF conversion.

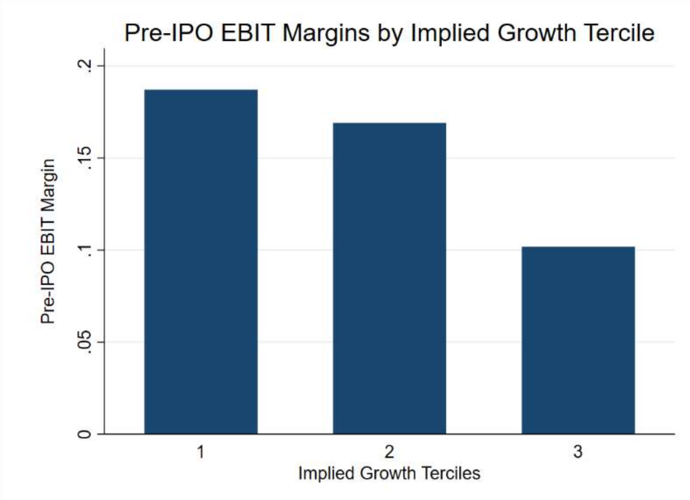


Figure 15: Average pre-IPO EBIT margins by implied expected revenue growth tercile, excluding financial firms. We take cross-sectional averages for values of EBIT margin on the year prior to IPO. As elsewhere in our thesis, implied growth is the revenue growth rate which satisfies the offer price, based on the valuation methodology detailed in Section 3.2. We winsorize implied growth at the 10^{th} and 90^{th} percentiles.

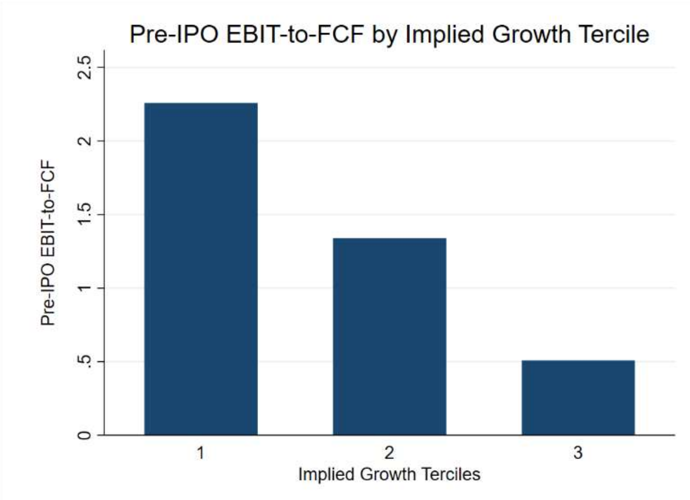


Figure 16: Average pre-IPO EBIT-to-FCF conversion ratios by implied expected revenue growth tercile, excluding financial firms. We take cross-sectional averages for values of EBIT-to-FCF on the year prior to IPO. Here, we report EBIT-to-FCF only for firms with a positive average post-IPO EBIT margin. As elsewhere in our thesis, implied growth is the revenue growth rate which satisfies the offer price, based on the valuation methodology detailed in Section 3.2. We winsorize implied growth at the 10^{th} and 90^{th} percentiles.

Another important finding at this stage is that pre-IPO revenue growth does not drive implied growth. Figure 17 shows that the relationship of 1^{st} day abnormal returns to pre-IPO revenue growth is opposite to its relationship with implied expected revenue growth. This suggests that pre-IPO growth and the implied growth measure we derive indeed measure different event windows. Figure 18 provides clearer evidence, showing that implied growth is highly clustered compared to pre-IPO growth, at values which tend to be lower than for pre-IPO growth.

Relative to 1^{st} day abnormal returns, underpricing exhibits a similar distributional relationship to implied growth and pre-IPO growth. We report the corresponding figures in Appendix 3.

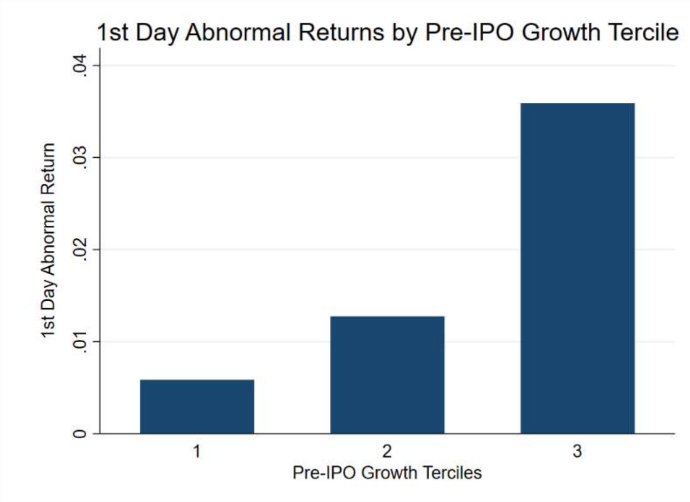


Figure 17: Average 1st day abnormal returns by pre-IPO revenue growth tercile, excluding financial firms. 1st day abnormal returns are equal to 1st day returns net of the market factor and risk-free rate observations for that day, using daily Fama French European 5 factor data. We measure pre-IPO growth as the revenue CAGR of each IPO firm during the 5-year window prior to its IPO. We winsorize both variables at the 10th and 90th percentiles.

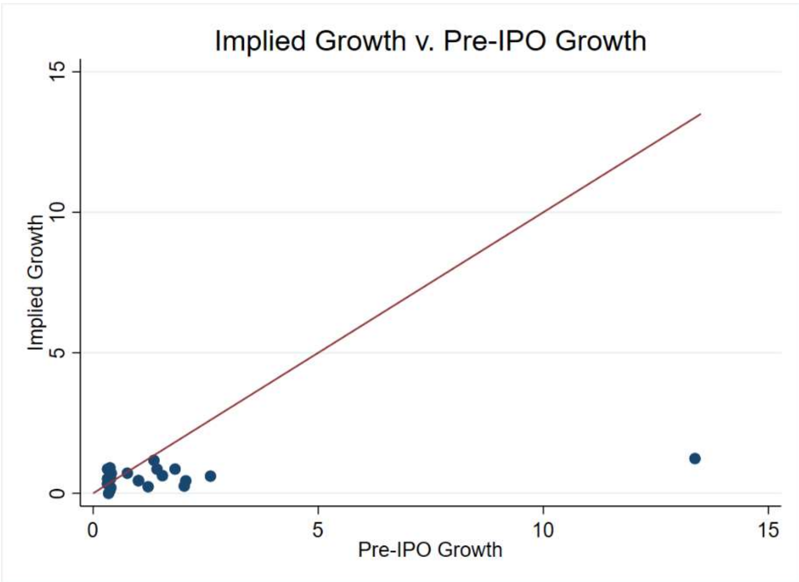


Figure 18: Implied expected revenue growth vs. pre-IPO revenue growth, excluding financial firms. The former is the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). The latter is the revenue CAGR during the five-year window ending the fiscal year prior to IPO. The red line depicts the relationship that would be observed if implied growth were equal to pre-IPO growth, whereas the scatterplot in blue displays the actual observed relationship. Neither variable is winsorized in this figure.

5.3.2 Long-Term Abnormal Returns and Growth

Figure 19 shows that long-term abnormal returns are monotonically increasing in implied growth. This contradicts our original expectation of long-run underperformance, which Ritter famously documented as the "new issues puzzle" (1991; Loughran & Ritter, 1995). We also observe that long-term abnormal returns are weakly monotonically increasing in post-IPO revenue growth (Figure 20). The scale remains in favor of implied growth considering this finding.

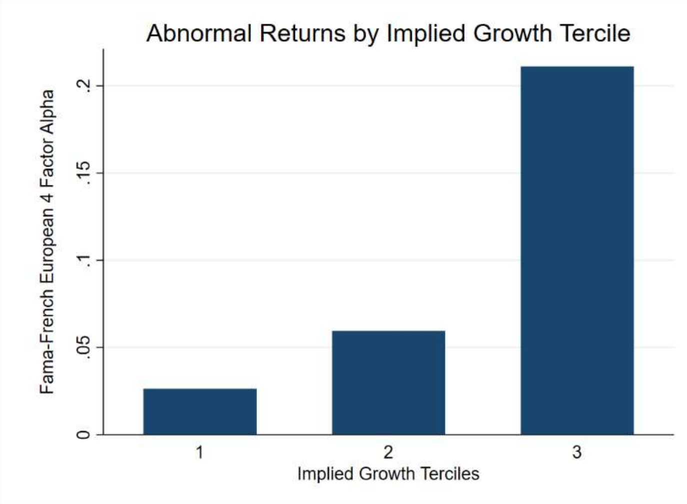


Figure 19: Average long-term abnormal returns by implied growth tercile, excluding financial firms. We estimate long-term abnormal returns as the annualized Fama French intercept for each firm (see Section 3.5). Implied growth is the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). We winsorize both variables at the 10th and 90th percentiles.

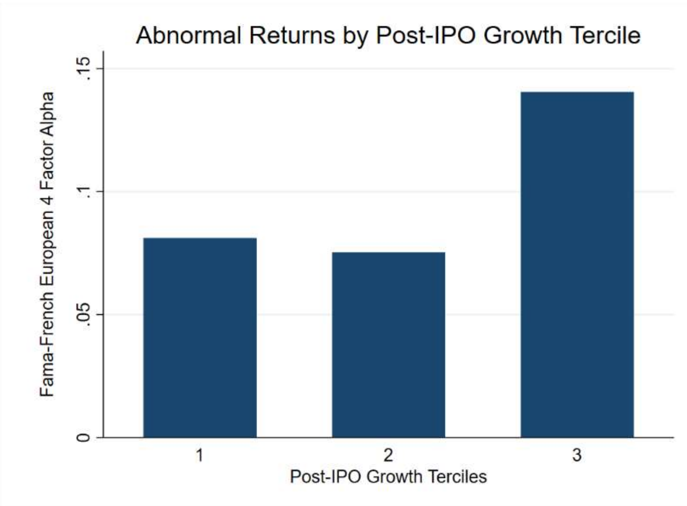


Figure 20: Average long-term abnormal returns by post-IPO growth tercile, excluding financial firms. We estimate long-term abnormal returns as the annualized European Fama French intercept for each firm (see Section 3.5). Post-IPO growth is revenue CAGR from the fiscal year before IPO until 2018. Both variables are winsorized at the 10th and 90th percentiles.

It is useful to revisit the idea that other valuation factors or measures of operational performance may better explain the observed relationship between implied growth and returns. Figure 21 and Figure 22 offer contradicting evidence against that notion because EBIT margins and EBIT-to-FCF are monotonically decreasing in implied growth. At least from a rational perspective, implied growth seems to offer a better explanation.

Let us clarify this idea in a way that is consistent with the explanation we offer for the relationship between implied growth and 1st day abnormal returns. Recall that (1) there is a negative relationship between implied growth and 1st day abnormal returns, (2) this may be a rational adjustment by risk-averse investors of over-optimistic growth assumptions associated to riskiness from lower EBIT margins and EBIT-to-FCF conversion, and (3) on average, our valuation assumptions – including implied revenue growth – match with valuation variable realizations. Tying these concepts together, it may be that the positive relationship we see between long-term abnormal returns and implied growth is due to an adjustment against risk-averse investors' initial skepticism about the growth assumptions for high-growth IPO firms, as they realize that these assumptions match with reality, on average.

Our growth-based explanation remains consistent for low-implied growth companies, which have both positive 1st day abnormal returns and positive long-term abnormal returns. Most of the companies whose post-IPO revenue growth outperforms their implied growth are in the low implied growth group (Figure 12). Hence, according to our explanation, skeptics of high growth assumptions do not punish these companies on their 1st day of trading, and investors reward those companies over the long term as they outperform their initial growth assumptions.

Our findings in Section 5.3 are robust to the inclusion of financial firms in our sample. We report the corresponding figures in Appendix 2.

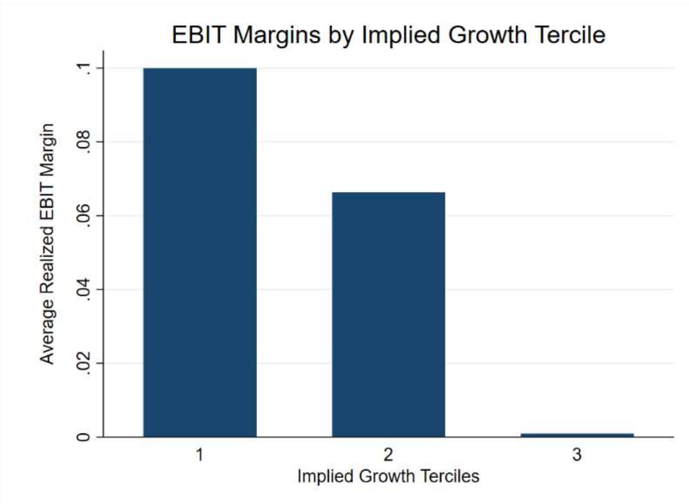


Figure 21: Cross-sectional means of average post-IPO EBIT margins by implied growth tercile, excluding financial firms. We measure average post-IPO EBIT margins for each high-growth firm from the fiscal year of IPO until 2018 and then compute cross-sectional means by implied growth tercile. Implied growth is the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). We winsorize implied growth at the 10th and 90th percentiles.

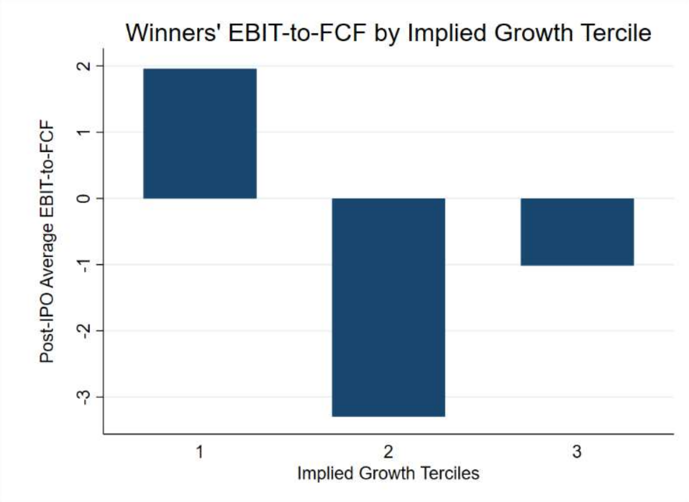


Figure 22: Cross-sectional means of average post-IPO EBIT-to-FCF conversion ratios by implied growth tercile, excluding financial firms. "Winners" refers to firms whose average post-IPO EBIT margin was greater than zero. We make this distinction to facilitate the interpretation of EBIT-to-FCF. We measure average post-IPO EBIT-to-FCF ratios for each high-growth firm from the fiscal year of IPO until 2018 and then compute cross-sectional means by implied growth tercile. Implied growth is the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). We winsorize implied growth at the 10th and 90th percentiles.

5.4 Regressions of Abnormal Returns on Implied Growth

We now examine relationships between abnormal equity returns and implied expected revenue growth using regressions. For conciseness, we report tests of robustness based on alternative regression specifications in Appendix 1.

5.4.1 1st Day Abnormal Returns and Growth

As anticipated from the distributional relationships observed in Section 5.2, our cross-sectional regressions yield evidence that implied expected revenue growth has a negative predictive relationship with 1st day abnormal returns. This relationship is predictive because implied expected revenue growth is based solely information that is available at market open on the day of IPO. The coefficient on the standardized variant of implied growth shows that for each standard deviation of implied revenue growth expectations, 1st day abnormal returns suffer by 12.6% (-0.3775 x 0.3335 x 100). This effect is close to the standard deviation of 1st day abnormal returns (11.7%). In our regressions, we also observe a significant negative relationship between 1st day abnormal returns and log B/M ratios, which occurs by construction, since both measures include the closing price on the date of IPO. Table 12 summarizes these results.

VARIABLES	(1) 1st Day Abnormal Returns	(2) 1st Day Abnormal Returns	(3) 1st Day Abnormal Returns	(4) 1st Day Abnormal Returns
Implied Growth	-0.3775**			
	(0.1454)			
Ln(B/M)	-0.0657**	-0.0657**	-0.0657**	-0.0657**
	(0.0272)	(0.0272)	(0.0272)	(0.0272)
Ln(Sales)	0.0112	0.0112	0.0112	0.0112
	(0.0125)	(0.0125)	(0.0125)	(0.0125)
EBIT Margin	0.1248	0.1248	0.1248	0.1248
	(0.1215)	(0.1215)	(0.1215)	(0.1215)
De-meaned Implied Growth		-0.3775**		
		(0.1454)		
Standardized Implied Growth			-0.0987**	
			(0.0380)	
Implied Growth Centered at 2 percent				-0.3775**
				(0.1454)
Constant	-0.0575	-0.2691	-0.2691	-0.0650
	(0.1927)	(0.1672)	(0.1672)	(0.1913)
Observations	17	17	17	17
R-squared	0.5441	0.5441	0.5441	0.5441
Adj. R2	0.3920	0.3920	0.3920	0.3920
F-test	5.8950	5.8950	5.8950	5.8950
Prob > F	0.0073	0.0073	0.0073	0.0073

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 12: Cross-sectional, firm-level regressions of 1st day abnormal returns on implied expected revenue growth and control variables, excluding financial firms. We measure 1st day abnormal returns as the 1st day return of each IPO, net of the market and risk-free rate returns at the date of IPO, using daily Fama French European 5 Factor data from the Kenneth French website. Implied growth is the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). Ln(B/M) is the natural log of total common book equity in the year prior to IPO, divided by market capitalization at 1st day close (find further details about the computation of this variable in Appendix 5). We measure EBIT margin in the fiscal year prior to IPO. Ln(Sales) is the natural log of sales in the year prior to IPO. For the variant of implied growth in column 4, we center by simply subtracting 2 percent from our initial measure of implied expected revenue growth. We winsorize 1st day abnormal returns, implied growth, and the variants of implied growth at the 10th and 90th percentiles. We use White's heteroscedasticity robust standard errors.

Our finding is robust to diverse variants of implied expected revenue growth at a 5 percent level of significance. Additionally, when we maintain the regression specification in Table 12 but substitute implied expected revenue growth and its variants for pre-IPO revenue CAGR and its variants, the coefficients on variants of revenue growth become insignificant, while the coefficient on pre-IPO EBIT Margin becomes significant. We also modify the specifications in Table 12 by adding, instead of substituting, corresponding variants of pre-IPO revenue CAGR (e.g., we include de-meaned pre-IPO revenue CAGR in the regression with de-meaned implied expected revenue growth). This does not affect the significance of implied expected revenue growth. Results corresponding to the regression specifications in Table 12 are also robust to the inclusion of financial firms in our sample. In fact, inclusion of financial firms raises the level of significance of the coefficients on the variants of implied growth to 1 percent.

We recognize that a small sample size, model imprecision, and the noise in our data limit the significance of our results. Keeping this in mind, and recalling our findings in Section 5.2, the most reasonable explanation we can offer for the negative predictive relationship between 1st day abnormal returns and implied expected revenue growth is that risk-averse investors rationally adjust against over-optimistic growth assumptions associated to riskiness from lower EBIT margins and EBIT-to-FCF conversion.

5.4.2 Long-Term Abnormal Returns and Growth

The cross-sectional regression of long-term abnormal returns on implied growth also matches the expectations we form based on the distributional relationships reported in Section 5.2. We observe a positive predictive relationship between implied expected revenue growth and long-term abnormal returns. The coefficient on the standardized variant of implied growth shows that for each standard deviation of implied revenue growth expectations, annual long-term abnormal returns increase by 4% (0.1203 x 0.3335 x 100). Table 13 summarizes our results.

As before, this finding is robust to diverse variants of implied expected revenue growth at a 5 percent level of significance. Additionally, when we maintain the regression specification in Table 13 but substitute implied expected revenue growth and its variants for post-IPO revenue CAGR and its variants, the coefficients on variants of revenue growth become insignificant. We also modify the specifications in Table 13 by adding, rather than substituting, corresponding variants of post-IPO revenue CAGR (e.g., we include standardized post-IPO revenue CAGR in the regression with standardized implied expected revenue growth). This only affects the significance of implied expected revenue growth in specifications that include R^2, where the level of significance of implied expected revenue growth becomes 10 percent. Results corresponding to the regression specifications in Table 13 are robust to the inclusion of financial firms in our sample at a 10 percent level of significance.

Would other valuation factors such as profitability, size, covariance with the market factor, or an alternative growth proxy eliminate the significance of implied expected revenue growth? We perform two separate tests to answer this question. In the first test, we add firm-level EBIT margin and SMB coefficients[6] to the specifications in Table 13, to control for profitability and size. Implied expected revenue growth remains significant at the 10 percent level. In the second test, we control for covariance with the market and an alternative proxy for growth by adding firm-level MKT and HML coefficients[6] to the specifications in Table 13. This has no effect on the significance of implied expected revenue growth.

Again, we admit the limitations of our study and note that our results for long-term abnormal returns are not as strong as for 1st day abnormal returns. With due consideration, but also with regard for our findings in Sections 5.2 and 5.3.1, we interpret the positive predictive relationship between long-term abnormal returns and implied expected revenue growth as an adjustment against risk-averse investors' initial skepticism about revenue growth expectations – which we proxy with implied growth – for high-growth IPO firms. In our view, the adjustment occurs as investors realize that high-growth firms can meet their initial growth expectations, on average (Table 11).

[6] The Fama French coefficients from time-series regressions of post-IPO return performance for each high-growth IPO, using monthly Fama French European 5 Factor data from the Kenneth French website.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Long-Term Abnormal Returns	Long-Term Abnormal Returns	Long-Term Abnormal Returns	Long-Term Abnormal Returns	Long-Term Abnormal Returns	Long-Term Abnormal Returns	Long-Term Abnormal Returns	Long-Term Abnormal Returns
VARIABLES								
Implied Growth	0.4600**	0.4601**						
	(0.2101)	(0.2121)						
Fama French R^2		-0.0018		-0.0018		-0.0018		-0.0018
		(0.2853)		(0.2853)		(0.2853)		(0.2853)
De-meaned Implied Growth			0.4600**	0.4601**				
			(0.2101)	(0.2121)				
Standardized Implied Growth					0.1203**	0.1203**		
					(0.0549)	(0.0555)		
Implied Growth Centered at 2 percent							0.4600**	0.4601**
							(0.2101)	(0.2121)
Constant	-0.1589	-0.1584	0.0989	0.0996	0.0989	0.0996	-0.1497	-0.1492
	(0.1294)	(0.1661)	(0.0624)	(0.1055)	(0.0624)	(0.1055)	(0.1257)	(0.1628)
Observations	21	21	21	21	21	21	21	21
R-squared	0.1569	0.1569	0.1569	0.1569	0.1569	0.1569	0.1569	0.1569
Adj. R2	0.1130	0.0633	0.1130	0.0633	0.1130	0.0633	0.1130	0.0633
F-test	4.7950	2.3900	4.7950	2.3900	4.7950	2.3900	4.7950	2.3900
Prob > F	0.0412	0.1200	0.0412	0.1200	0.0412	0.1200	0.0412	0.1200

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13: Cross-sectional, firm-level regressions of long-term abnormal returns on implied expected revenue growth and Fama French R^2, excluding financial firms. We estimate long-term abnormal returns as the annualized European Fama French intercept for each firm (see Section 3.5 for detailed steps for estimation). Fama French R^2 is the R^2 from the aforementioned time-series regressions, and we use it as a control for the effect of the imprecision of the Fama French model on the estimation of abnormal returns. Implied growth is the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). In columns 7-8, we center implied growth by subtracting 2 percent from our initial measure of implied expected revenue growth. We winsorize long-term abnormal returns, implied growth, and the variants of implied growth at the 10th and 90th percentiles. We use White's heteroscedasticity robust standard errors.

5.5 Summary of Hypotheses and Results

Hypothesis 1: Underpricing

- Expectation: positive first day returns. Our results: negative first day returns on average, with negative skewness in the distribution. High standard errors render the mean statistically insignificant unless we winsorize.

Hypothesis 2: Long-term underperformance

- Expectation: negative abnormal returns. Our results: after winsorizing at the 10^{th} and 90^{th} percentiles, the mean annualized abnormal annual return is 17%, which contradicts our initial hypothesis. High standard errors render the mean statistically insignificant unless we winsorize.

Hypothesis 3: Underperformance of post-IPO growth relative to implied growth

- Expectation: realized growth underperforms expectations proxied by implied growth. Our results: consistency with our initial hypothesis for individual observations, but not statistically for the entire cohort. On average, high-growth IPOs meet growth expectations, which we proxy with implied growth.

Hypothesis 4: Persistence of pre-IPO revenue growth into the post-IPO period

- Expectation: revenue growth persistence. Our results: statistically no persistence.

Hypothesis 5a: Relationship between 1^{st} day abnormal returns and implied growth

- Expectation: positive relationship. Our results: weakly monotonically decreasing relationship. The higher the implied growth is, the smaller – even more negative – the abnormal returns.

Hypothesis 5b: Relationship between long-term abnormal returns and implied growth

- Expectation: negative relationship. Our results: positive relationship.

5.6 Alternative Explanations for Results

The main limitation in comparing our results with those from prior research is the size of our sample and its effect on the meaningfulness of our findings. Having recognized this issue, we momentarily set it aside to enrich our discussion by relating our results to explanations provided by prior research.

5.6.1 Empirically Observed Revenue Growth Drivers

Does some other factor we have not thought of drive our measure of growth expectations? To answer this question, we consider the study by Baghai, M., Smit, S., & Viguerie, S. (2007). The authors examine the forces that drive revenue growth, splitting them into three broad categories: (1) industry segment market growth, (2) merger & acquisition gains, and (3) change in market share, where the first two explain approximately 80 percent of total revenue growth. If the findings by Baghai et al. (2007) hold in our sample, we should observe a strong correlation between industry market growth and post-IPO revenue growth. Furthermore, if the market has internalized these findings and extrapolates past performance (Lakonishok et al., 1994), pre-IPO industry segment market growth should correlate strongly with implied expected revenue growth (assuming that implied growth is a good proxy for revenue growth expectations).

We perform a quick test by estimating the correlations between pre-IPO industry segment market growth, post-IPO industry segment market growth, implied expected revenue growth, and post-IPO revenue growth. Industry segment market growth is our variable of focus because merger & acquisition transactions are excluded from our valuation methodology. We measure industry segment market growth using annualized average monthly industry ETF returns as proxies, matching industry ETFs to the high-growth IPOs in our sample based on similarity between segments. For example, we use the Vanguard Real Estate Index Fund ETF as an industry segment market proxy for the growth of real estate companies. For 6 companies that do not have an appropriate ETF, we use a market index instead.

Table 14 and Table 15 summarize our findings. Due to the relatively low correlations, we conclude that industry segment market growth does not explain the implied expected revenue growth and post-IPO revenue growth measures we obtain from our sample.

	Pre-IPO Annualized Index Return	Post-IPO Annualized Index Return
Implied growth	0,2312	0,2540
Realized growth	0,0855	0,0713

*excluding financial companies

Table 14: Correlation matrix for industry market index returns and growth rates for high-growth companies, excluding financial firms. First, we download historical monthly price data for the industry indices from Eikon. We select the indices based on their composition and their representation of the industry for the corresponding high-growth firm. For those high growth firms that do not have a matching index, we use their country market index instead. Then, we calculate the pre-IPO and post-IPO annualized rate of return for each index (based on closing prices). Implied growth is the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). Realized growth is post-IPO revenue CAGR, which we measure from the fiscal year prior to IPO until 2018.

	Pre-IPO Annualized Index Return	Post-IPO Annualized Index Return
Implied growth	0,2883	0,0521
Realized growth	0,1894	0,0259

*adding financial companies

Table 15: Correlation matrix for index returns and growth rates of high-growth companies, including financial firms. First, we download historical monthly price data for the industry indices from Eikon. We select the indices based on their composition and their representation of the industry for the corresponding high-growth firm. For those high growth companies that do not have index, we use their country market index instead. Then, we calculate the pre-IPO and post-IPO annualized rate of return for each index (based on closing prices). Implied growth is the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). Realized growth is post-IPO revenue CAGR, measured from the fiscal year prior to IPO until 2018.

5.6.2 Windows of Opportunity and Divergence of Opinion

The "windows of opportunity" (Ritter, 1991; Loughran & Ritter, 1995) and "divergence of opinion" (Miller, 1977) hypotheses do not explain our results. These hypotheses motivate our original expectation that Nordic high-growth firms would exhibit underpricing and long-term underperformance. Taken together with Kim and Ritter's findings (1999), the two referred hypotheses also motivate our original expectation that implied growth would have a positive relation with 1st day abnormal returns and a negative relationship with long-term abnormal returns. The aforementioned hypotheses address IPOs in general, so it is possible that our results contradict prior evidence for the hypotheses because high-growth IPOs are *special*.

5.6.3 The Extrapolation Hypothesis

The extrapolation hypothesis (Lakonishok et al., 1994) is related to our findings, but it does not offer a complete explanation for them. As a reminder, Lakonishok et al. (1994) identify extrapolation in their research as the expectational error that past growth performance will persist in the future. We consider the hypothesis in the revenue growth dimension.

From the point of view that equity market values capture information about growth expectations, we observe extrapolation in our sample in the positive relationship between pre-IPO growth and 1st day abnormal returns (*Figure 17*). However, we find that relationship to be insignificant in our regressions (Appendix 1). Additionally, taking growth as a proxy for growth expectations, extrapolation does not explain (1) the weak correlation we observe between pre-IPO revenue CAGRs and implied expected growth rates (Table 8), nor (2) the negative relationship between implied expected growth rate and 1st day abnormal returns (Table 12). Indeed, negative predictive relationships between growth expectations and future stock return performance are evidence of extrapolation. But the economic explanation for these relationships is that extreme initial expectations exhibit mean reversion as investors observe realized performance (Lakonishok et al., 1994; La Porta, 1996). The negative relationship we observe between implied expected growth rates and 1st day abnormal returns certainly does not arise from a response to ex post performance. Rather, it could be an adjustment for sources of risk such as low profitability or cash flow conversion ability (Figure 15 – Figure 16).

We also observe some evidence of extrapolation in the relationship between post-IPO revenue CAGRs and long-term abnormal returns (Figure 20). Nonetheless, as with 1st day abnormal returns, the relationship is insignificant according to regression analysis (Appendix 1), unlike the relationship between implied growth and long-term abnormal returns (Table 13). Moreover, an extrapolation explanation would undermine the fact that implied growth is on average equal to post-IPO revenue CAGR in our sample (Table 11). Thus, while we cannot rule out extrapolation as a partial explanation for our results, we favor our own explanation because it better accounts for our overall findings.

6 Summary and Conclusions

We study Nordic high-growth firms that have gone public from 2012 – 2017. We identify high-growth companies as those above the 66th cross-sectional percentile of pre-IPO revenue CAGR, measuring CAGR over the 5-year window prior to IPO. Our contribution to existing literature consists in investigating whether previous findings about growth and IPO return performance also apply to high-growth firms specifically. We assess the degree to which high-growth firms can meet the growth expectations that their offer prices imply, examine the persistence of revenue growth from pre-IPO into the post-IPO period, test the presence of underpricing and long-term underperformance in our sample, and examine the relationships between IPO abnormal returns and implied growth.

We find that Nordic high-growth companies: (1) meet growth expectations, on average; (2) do not have persistent revenue growth rates; (3) are not underpriced, having an average[7] 1st day return of 2.1%; (4) do not underperform in the long-term, with average[7] annual Fama French abnormal returns estimated at 17%; (5) suffer a decline of 12.6% in 1st day abnormal returns for each standard deviation of implied growth; (6) obtain an extra 12% in annualized Fama French abnormal returns for every standard deviation of implied growth.

The results we find contradict prior research and our initial expectations. Our small sample size introduces estimation error in our results, but we momentarily set aside this issue to present an alternative explanation. The previous evidence we cite focuses on either firms or IPOs in general. It is possible that our results differ from prior research because high-growth firms are *special*. Under this view, we interpret the negative relationship between 1st day abnormal returns and implied growth as a risk adjustment against offer prices, which is increasing in the aggressiveness of the growth expectations that justify those prices. Additionally, we interpret the positive predictive relationship between long-term abnormal returns and implied growth as an adjustment against risk-averse investors' initial skepticism, as investors realize that high-growth IPOs can meet their initial growth expectations, on average.

We acknowledge the importance of further research on our chosen topic. A starting point could be to replicate our study with a larger sample size. This is a dire challenge in Nordic markets, due to their small size, but larger markets such as the US and Asia would suit well. Furthermore, an international sample would allow future researchers to learn whether our findings are internationally manifest. Future research could also update our study with a standardized measurement period for post-IPO revenue growth and return performance. Lastly, future studies could expand our research by testing the relationship between high-growth companies' abnormal returns and multiple proxies for growth expectations.

[7] We report winsorized means with cutoffs at the 10th and 90th percentiles.

Appendix 1

Additional tests of robustness for abnormal return – implied growth regressions.

VARIABLES	(1) 1st Day Abnormal Returns	(2) 1st Day Abnormal Returns	(3) 1st Day Abnormal Returns	(4) 1st Day Abnormal Returns
Implied Growth	-0.4459***			
	(0.1409)			
Ln(B/M)	-0.0737**	-0.0737**	-0.0737**	-0.0737**
	(0.0341)	(0.0341)	(0.0341)	(0.0341)
Ln(Sales)	-0.0034	-0.0034	-0.0034	-0.0034
	(0.0145)	(0.0145)	(0.0145)	(0.0145)
EBIT Margin	-0.0287	-0.0287	-0.0287	-0.0287
	(0.0672)	(0.0672)	(0.0672)	(0.0672)
De-meaned Implied Growth		-0.4459***		
		(0.1409)		
Standardized Implied Growth			-0.1438***	
			(0.0455)	
Implied Growth Centered at 2 percent				-0.4459***
				(0.1409)
Constant	0.1845	-0.0480	-0.0480	0.1756
	(0.2041)	(0.2025)	(0.2025)	(0.2035)
Observations	19	19	19	19
R-squared	0.4936	0.4936	0.4936	0.4936
Adj. R2	0.3490	0.3490	0.3490	0.3490
F-test	3.7250	3.7250	3.7250	3.7250
Prob > F	0.0288	0.0288	0.0288	0.0288

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 16: Cross-sectional, firm-level regressions of 1st day abnormal returns on implied expected revenue growth and control variables, including financial firms. We measure 1st day abnormal returns as the 1st day return of each IPO, net of the market and risk. We measure implied growth as the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). We measure Ln(B/M) as total common book equity in the year prior to IPO, divided by market capitalization at 1st day close (find further details about the computation of this variable in Appendix 5). Ln(Sales) is the natural log of sales in the year prior to IPO. We measure EBIT margin in the fiscal year prior to IPO. For the variant of implied growth in column 4, we center by simply subtracting 2 percent from our initial measure of implied expected revenue growth. We winsorize 1st day abnormal returns, implied growth and the variants of implied growth at the 10th and 90th percentiles. We use White's heteroscedasticity robust standard errors.

	(1)	(2)	(3)	(4)
VARIABLES	1st Day Abnormal Returns	1st Day Abnormal Returns	1st Day Abnormal Returns	1st Day Abnormal Returns
Pre-IPO Growth	-0.0523			
	(0.0656)			
Ln(B/M)	-0.0004	-0.0004	-0.0004	-0.0004
	(0.0159)	(0.0159)	(0.0159)	(0.0159)
Ln(Sales)	-0.0037	-0.0037	-0.0037	-0.0037
	(0.0230)	(0.0230)	(0.0230)	(0.0230)
EBIT Margin	0.3610**	0.3610**	0.3610**	0.3610**
	(0.1336)	(0.1336)	(0.1336)	(0.1336)
De-meaned Implied Growth		-0.0523		
		(0.0656)		
Standardized Implied Growth			-0.0360	
			(0.0451)	
Implied Growth Centered at 2 percent				-0.0523
				(0.0656)
Constant	0.0600	0.0063	0.0063	0.0590
	(0.3750)	(0.3203)	(0.3203)	(0.3739)
Observations	17	17	17	17
R-squared	0.2705	0.2705	0.2705	0.2705
Adj. R2	0.0274	0.0274	0.0274	0.0274
F-test	4.005	4.005	4.005	4.005
Prob > F	0.0273	0.0273	0.0273	0.0273

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 17: Cross-sectional, firm-level regressions of 1st day abnormal returns on pre-IPO revenue growth and control variables, excluding financial firms. We measure 1st day abnormal returns as the 1st day return of each IPO, net of the market and risk. We measure pre-IPO revenue CAGR over the 5-year window prior to each IPO date. We measure Ln(B/M) as total common book equity in the year prior to IPO, divided by market capitalization at 1st day close (find further details about the computation of this variable in Appendix 5). Ln(Sales) is the natural log of sales in the year prior to IPO. We measure EBIT margin in the fiscal year prior to IPO. For the variant of implied growth in column 4, we center by simply subtracting 2 percent from our initial measure of implied expected revenue growth. We winsorize 1st day abnormal returns, pre-IPO growth and the variants of pre-IPO growth at the 10th and 90th percentiles. We use White's heteroscedasticity robust standard errors.

VARIABLES	(1) 1st Day Abnormal Returns	(2) 1st Day Abnormal Returns	(3) 1st Day Abnormal Returns	(4) 1st Day Abnormal Returns
Implied Growth	-0.3734**			
	(0.1407)			
Pre-IPO Growth	-0.0045			
	(0.0403)			
Ln(B/M)	-0.0645**	-0.0645**	-0.0645**	-0.0645**
	(0.0264)	(0.0264)	(0.0264)	(0.0264)
Ln(Sales)	0.0101	0.0101	0.0101	0.0101
	(0.0186)	(0.0186)	(0.0186)	(0.0186)
EBIT Margin	0.1337	0.1337	0.1337	0.1337
	(0.1250)	(0.1250)	(0.1250)	(0.1250)
De-meaned Implied Growth		-0.3734**		
		(0.1407)		
De-meaned Pre-IPO Growth		-0.0045		
		(0.0403)		
Standardized Implied Growth			-0.0976**	
			(0.0368)	
Standardized Pre-IPO Growth			-0.0031	
			(0.0278)	
Implied Growth Centered at 2 percent				-0.3734**
				(0.1407)
Pre-IPO Growth Centered at 2 percent				-0.0045
				(0.0403)
Constant	-0.0402	-0.2542	-0.2542	-0.0478
	(0.2976)	(0.2438)	(0.2438)	(0.2958)
Observations	17	17	17	17
R-squared	0.5444	0.5444	0.5444	0.5444
Adj. R2	0.337	0.337	0.337	0.337
F-test	4.449	4.449	4.449	4.449
Prob > F	0.0184	0.0184	0.0184	0.0184

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 18: Cross-sectional, firm-level regressions of 1st day abnormal returns on implied expected revenue growth, pre-IPO growth and control variables, excluding financial firms. We measure 1st day abnormal returns as the 1st day return of each IPO, net of the market and risk. We measure implied growth as the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). We measure pre-IPO revenue CAGR over the 5-year window prior to each IPO date. We measure Ln(B/M) as total common book equity in the year prior to IPO, divided by market capitalization at 1st day close Appendix 5). We measure Ln(Sales) and EBIT margin as of the year prior to IPO. For the variant of implied growth in column 4, we center by simply subtracting 2 percent from our initial measure of implied expected revenue growth. For the variant of pre-IPO growth in column 4, we center by simply subtracting 2 percent from our pre-IPO revenue growth. We winsorize 1st day abnormal returns, implied growth, pre-IPO growth and the variants of implied growth and pre-IPO growth at the 10th and 90th

VARIABLES	(1) Long-Term Abnormal Returns	(2) Long-Term Abnormal Returns	(3) Long-Term Abnormal Returns	(4) Long-Term Abnormal Returns	(5) Long-Term Abnormal Returns	(6) Long-Term Abnormal Returns	(7) Long-Term Abnormal Returns	(8) Long-Term Abnormal Returns
Implied Growth	0.2883*	0.3076*						
	(0.1633)	(0.1589)						
Fama French R^2		-0.1122		-0.1122		-0.1122		-0.1122
		(0.2639)		(0.2639)		(0.2639)		(0.2639)
De-meaned Implied Growth			0.2883*	0.3076*				
			(0.1633)	(0.1589)				
Standardized Implied Growth					0.0930*	0.0992*		
					(0.0527)	(0.0513)		
Implied Growth Centered at 2 percent							0.2883*	0.3076*
							(0.1633)	(0.1589)
Constant	-0.0509	-0.0207	0.0994*	0.1397	0.0994*	0.1397	-0.0451	-0.0145
	(0.1009)	(0.1228)	(0.0570)	(0.0972)	(0.0570)	(0.0972)	(0.0983)	(0.1209)
Observations	24	24	24	24	24	24	24	24
R-squared	0.1040	0.1109	0.1040	0.1109	0.1040	0.1109	0.1040	0.1109
Adj. R2	0.0633	0.0263	0.0633	0.0263	0.0633	0.0263	0.0633	0.0263
F-test	3.1150	1.9050	3.1150	1.9050	3.1150	1.9050	3.1150	1.9050
Prob > F	0.0914	0.1740	0.0914	0.1740	0.0914	0.1740	0.0914	0.1740

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 19: Cross-sectional, firm-level regressions of long-term abnormal returns on implied expected revenue growth and control variables, including financial firms. We estimate long-term abnormal returns as the annualized alpha from time-series regressions of high-growth IPO returns in excess of the risk-free rate on MKT, SMB, HML and RMW, using monthly European Fama French 5 Factor data from the Kenneth French website (see Section 3.5 for detailed steps for estimation). Fama French R^2 is the R^2 for the aforementioned time-series regressions. For the variant of implied growth in column 7-8, we center by simply subtracting 2 percent from our initial measure of implied expected revenue growth. We winsorize long-term abnormal returns, implied growth and the variants of implied growth at the 10^{th} and 90^{th} percentiles. We use White's heteroscedasticity robust standard errors.

VARIABLES	(1) Long-Term Abnormal Returns	(2) Long-Term Abnormal Returns	(3) Long-Term Abnormal Returns	(4) Long-Term Abnormal Returns	(5) Long-Term Abnormal Returns	(6) Long-Term Abnormal Returns	(7) Long-Term Abnormal Returns	(8) Long-Term Abnormal Returns
Realized Growth	0.1580	0.1597						
	(0.2368)	(0.2406)						
R-squared		-0.0096		-0.0096		-0.0096		-0.0096
		(0.2806)		(0.2806)		(0.2806)		(0.2806)
De-meaned Realized Growth			0.1580	0.1597				
			(0.2368)	(0.2406)				
Standardized Realized Growth					0.0493	0.0498		
					(0.0739)	(0.0751)		
Realized Growth Centered at 2 percent							0.1580	0.1597
							(0.2368)	(0.2406)
Constant	0.0484	0.0514	0.0989	0.1024	0.0989	0.1024	0.0516	0.0546
	(0.0767)	(0.1228)	(0.0671)	(0.1193)	(0.0671)	(0.1193)	(0.0739)	(0.1212)
Observations	21	21	21	21	21	21	21	21
R-squared	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264
Adj. R2	-0.0249	-0.0818	-0.0249	-0.0818	-0.0249	-0.0818	-0.0249	-0.0818
F-test	0.445	0.220	0.445	0.220	0.445	0.220	0.445	0.220
Prob > F	0.513	0.804	0.513	0.804	0.513	0.804	0.513	0.804

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 20: Cross-sectional, firm-level regressions of long-term abnormal returns on realized growth and control variables, excluding financial firms. We estimate long-term abnormal returns as the annualized alpha from time-series regressions of high-growth IPO returns in excess of the risk-free rate on MKT, SMB, HML and RMW, using monthly European Fama French 5 Factor data from the Kenneth French website (see Section 3.5 for detailed steps for estimation). Realized growth is firm-level post-IPO revenue CAGR, that we measure from the fiscal year prior to IPO until 2018. Fama French R^2 is the R^2 for the aforementioned time-series regressions. For the variant of realized growth in column 7-8, we center by simply subtracting 2 percent from our initial realized revenue growth. We winsorize long-term abnormal returns, implied (realized) growth and the variants of implied (realized) growth at the 10^{th} and 90^{th} percentiles. We use White's heteroscedasticity robust standard errors.

VARIABLES	(1) Long-Term Abnormal Returns	(2) Long-Term Abnormal Returns	(3) Long-Term Abnormal Returns	(4) Long-Term Abnormal Returns	(5) Long-Term Abnormal Returns	(6) Long-Term Abnormal Returns	(7) Long-Term Abnormal Returns	(8) Long-Term Abnormal Returns
Implied Growth	0.4402**	0.4408*						
	(0.2054)	(0.2098)						
Realized Growth	0.0685	0.0728						
	(0.2678)	(0.2708)						
R-squared		-0.0258		-0.0258		-0.0258		-0.0258
		(0.2576)		(0.2576)		(0.2576)		(0.2576)
De-meaned Implied Growth			0.4402**	0.4408*				
			(0.2054)	(0.2098)				
De-meaned Realized Growth			0.0685	0.0728				
			(0.2678)	(0.2708)				
Standardized Implied Growth					0.1151**	0.1153*		
					(0.0537)	(0.0548)		
Standardized Realized Growth					0.0214	0.0227		
					(0.0836)	(0.0845)		
Implied Growth Centered at 2 percent							0.4402**	0.4408*
							(0.2054)	(0.2098)
Realized Growth Centered at 2 percent							0.0685	0.0728
							(0.2678)	(0.2708)
Constant	-0.1697	-0.1621	0.0989	0.1083	0.0989	0.1083	-0.1595	-0.1519
	(0.1487)	(0.1768)	(0.0640)	(0.1084)	(0.0640)	(0.1084)	(0.1430)	(0.1717)
Observations	21	21	21	21	21	21	21	21
R-squared	0.1616	0.1619	0.1616	0.1619	0.1616	0.1619	0.1616	0.1619
Adj. R2	0.0684	0.0140	0.0684	0.0140	0.0684	0.0140	0.0684	0.0140
F-test	2.301	1.482	2.301	1.482	2.301	1.482	2.301	1.482
Prob > F	0.129	0.255	0.129	0.255	0.129	0.255	0.129	0.255

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 21: Cross-sectional, firm-level regressions of long-term abnormal returns on implied expected revenue growth, realized revenue growth and control variables, excluding financial firms. We estimate long-term abnormal returns as the annualized alpha from time-series regressions of high-growth IPO returns in excess of the risk-free rate on MKT, SMB, HML and RMW, using monthly European Fama French 5 Factor data from the Kenneth French website (see Section 3.5 for detailed steps for estimation). We measure implied growth as the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). Realized growth is firm-level post-IPO revenue CAGR, which we measure from the fiscal year prior to IPO until 2018. Fama French R^2 is the R^2 for the aforementioned time-series regressions. For the variant of realized growth in column 7-8, we center by simply subtracting 2 percent from our initial realized revenue growth. For the variant of realized growth in column 7-8, we center by simply subtracting 2 percent from our initial realized revenue growth. We winsorize long-term abnormal returns, implied (realized) growth and the variants of implied (realized) growth at the 10^{th} and 90^{th} percentiles. We use White's heteroscedasticity robust standard errors.

VARIABLES	(1) Long-Term Abnormal Returns	(2) Long-Term Abnormal Returns	(3) Long-Term Abnormal Returns	(4) Long-Term Abnormal Returns
Implied Growth	0.4834*			
	(0.2538)			
β_{SMB}	-0.0053	-0.0053	-0.0053	-0.0053
	(0.0155)	(0.0155)	(0.0155)	(0.0155)
Average Post-IPO EBIT Margin	0.2085	0.2085	0.2085	0.2085
	(0.4383)	(0.4383)	(0.4383)	(0.4383)
De-meaned Implied Growth		0.4834*		
		(0.2538)		
Standardized Implied Growth			0.1264*	
			(0.0664)	
Implied Growth Centered at 2 percent				0.4834*
				(0.2538)
Constant	-0.1912	0.0799	0.0799	-0.1815
	(0.1629)	(0.0613)	(0.0613)	(0.1582)
Observations	21	21	21	21
R-squared	0.1855	0.1855	0.1855	0.1855
Adj. R2	0.0418	0.0418	0.0418	0.0418
F-test	1.377	1.377	1.377	1.377
Prob > F	0.284	0.284	0.284	0.284

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 22: Cross-sectional, firm-level regressions of long-term abnormal returns on implied expected revenue growth and controls for size and profitability, excluding financial firms. We estimate long-term abnormal returns as the annualized alpha from time-series regressions of high-growth IPO returns in excess of the risk-free rate on MKT, SMB, HML and RMW, using monthly European Fama French 5 Factor data from the Kenneth French website (see Section 3.5 for detailed steps for estimation). β_{SMB} contains the coefficients on SMB from these regressions. We measure verage post-IPO EBIT margin from the fiscal year prior to IPO until 2018. For the variant of implied growth in column 4, we center by simply subtracting 2 percent from our initial measure of implied expected revenue growth. We winsorize long-term abnormal returns, implied growth and the variants of implied growth at the 10^{th} and 90^{th} percentiles. We use White's heteroscedasticity robust standard errors.

VARIABLES	(1) Long-Term Abnormal Returns	(2) Long-Term Abnormal Returns	(3) Long-Term Abnormal Returns	(4) Long-Term Abnormal Returns
Implied Growth	0.4325**			
	(0.1970)			
β_{MKT}	0.0380**	0.0380**	0.0380**	0.0380**
	(0.0167)	(0.0167)	(0.0167)	(0.0167)
β_{HML}	-0.0530	-0.0530	-0.0530	-0.0530
	(0.0327)	(0.0327)	(0.0327)	(0.0327)
De-meaned Implied Growth		0.4325**		
		(0.1970)		
Standardized Implied Growth			0.1131**	
			(0.0515)	
Implied Growth Centered at 2 percent				0.4325**
				(0.1970)
Constant	-0.2144	0.0281	0.0281	-0.2058
	(0.1562)	(0.0751)	(0.0751)	(0.1526)
Observations	21	21	21	21
R-squared	0.3369	0.3369	0.3369	0.3369
Adj. R2	0.220	0.220	0.220	0.220
F-test	8.439	8.439	8.439	8.439
Prob > F	0.00118	0.00118	0.00118	0.00118

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 23: Cross-sectional, firm-level regressions of long-term abnormal returns on implied expected revenue growth controlling for loadings on MKT and HML, excluding financial firms. We estimate long-term abnormal returns as the annualized alpha from time-series regressions of high-growth IPO returns in excess of the risk-free rate on MKT, SMB, HML and RMW, using monthly European Fama French 5 Factor data from the Kenneth French website (see Section 3.5 for detailed steps for estimation). β_{MKT} and β_{HML} contain the coefficients on MKT and HML from these regressions. For the variant of implied growth in column 4, we center by simply subtracting 2 percent from our initial measure of implied expected revenue growth. We winsorize long-term abnormal returns, implied growth and the variants of implied growth at the 10^{th} and 90^{th} percentiles. We use White's heteroscedasticity robust standard errors.

Appendix 2

Figures from Section 5.3, including financial firms.

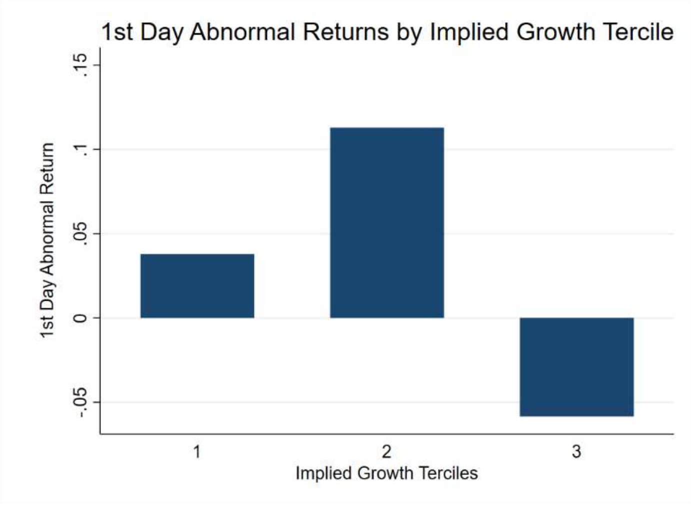


Figure 23: Average 1st day abnormal returns by cross-sectional implied growth terciles, including financial firms. 1st day abnormal returns are equal to 1st day returns net of the market factor and risk-free rate observations for that day, using daily Fama French European 5 factor data. As elsewhere in our thesis, implied growth is the revenue growth rate which satisfies the offer price, based on the valuation methodology detailed in Section 3.2. We winsorize both variables at the 10th and 90th percentiles.

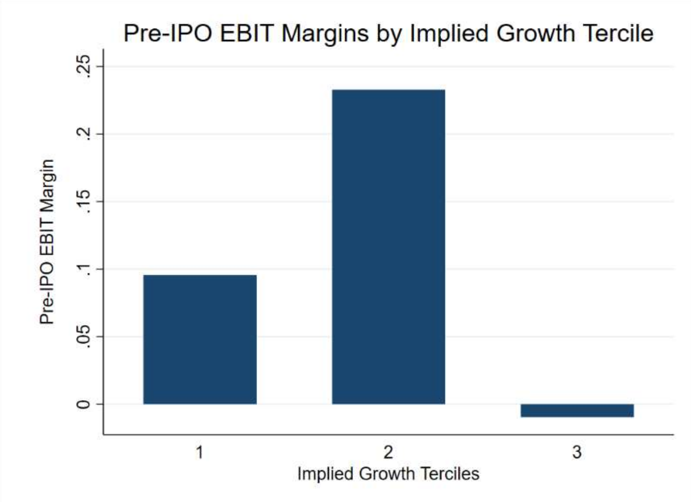


Figure 24: Average pre-IPO EBIT margins by implied expected revenue growth tercile, including financial firms. We take cross-sectional averages for values of EBIT margin on the year prior to IPO. As elsewhere in our thesis, implied growth is the revenue growth rate which satisfies the offer price, based on the valuation methodology detailed in Section 3.2. We winsorize implied expected revenue growth at the 10th and 90th percentiles.

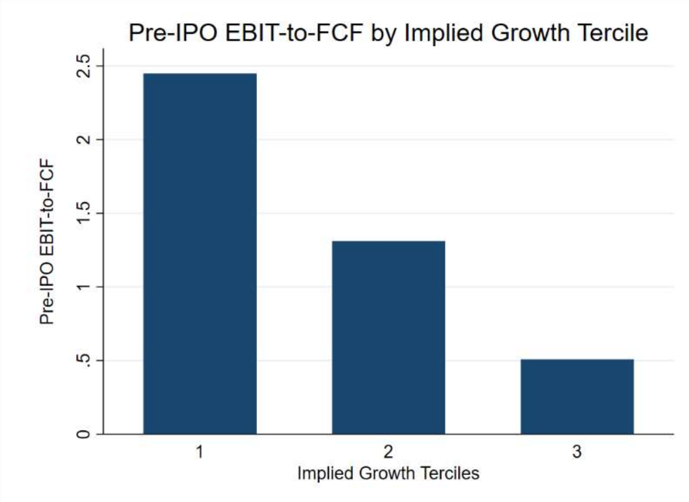


Figure 25: Average pre-IPO EBIT-to-FCF conversion ratios by implied expected revenue growth tercile, including financial firms. We take cross-sectional averages for values of EBIT-to-FCF on the year prior to IPO. EBIT-to-FCF corresponds here corresponds only to firms with a positive contemporaneous EBIT margin. As elsewhere in our thesis, implied growth is the revenue growth rate which satisfies the offer price, based on the valuation methodology detailed in Section 3.2. We winsorize implied expected revenue growth at the 10th and 90th percentiles.

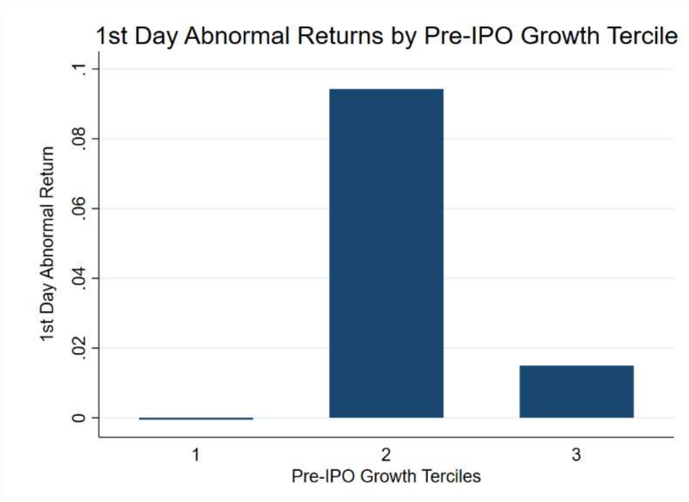


Figure 26: Average 1st Day abnormal returns by pre-IPO revenue growth tercile, including financial firms. 1st day abnormal returns are equal to 1st day returns net of the market factor and risk-free rate observations for that day, using daily Fama French European 5 factor data. Pre-IPO growth is measured as the revenue CAGR of each IPO firm during the 5-year window prior to its IPO. We winsorize both variables at the 10th and 90th percentiles.

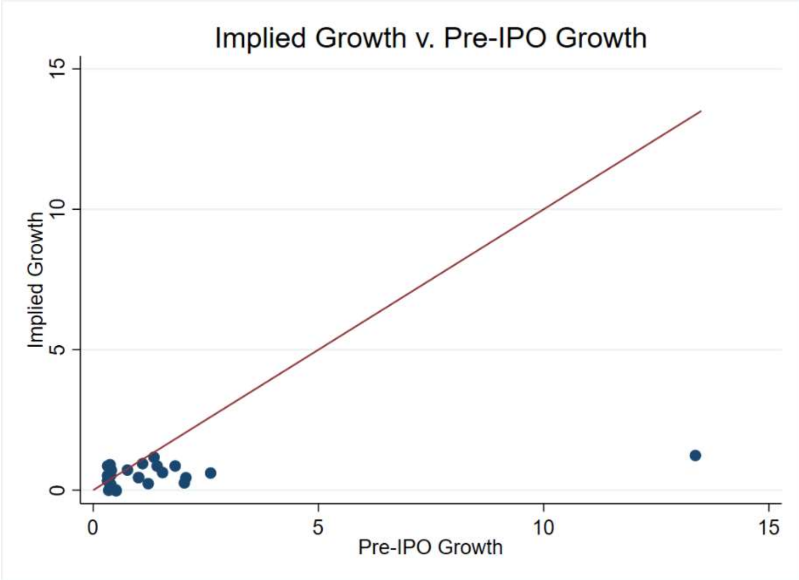


Figure 27: Implied expected revenue growth vs. pre-IPO revenue growth, including financial firms. We measure the former as the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). The latter is the revenue CAGR during the five-year window ending the fiscal year prior to IPO. The red line depicts the relationship that we would observe if implied growth were equal to pre-IPO growth, whereas the scatterplot in blue displays the actual observed relationship. Neither variable is winsorized in this figure.

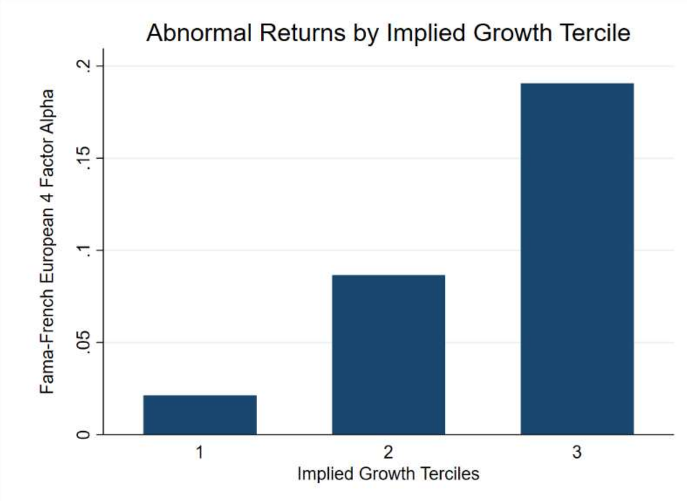


Figure 28: Average long-term abnormal returns by implied growth tercile, including financial firms. Long-term abnormal returns are measured as the annualized Fama French alpha, using the monthly European MKT, SMB, HML, and RMW factors from the Kenneth French website. We measure implied growth as the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). We winsorize both variables at the 10th and 90th percentiles.

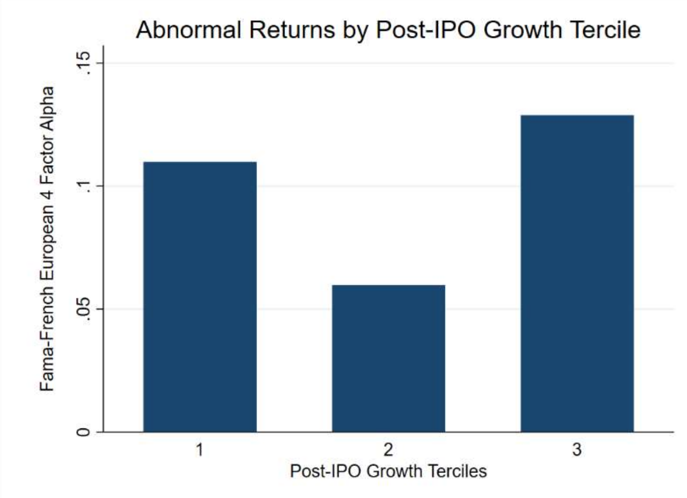


Figure 29: Average long-term abnormal returns by implied growth tercile, including financial firms. We measure long-term abnormal returns as the annualized Fama French alpha, using the monthly European MKT, SMB, HML, and RMW factors from the Kenneth French website. We measure post-IPO growth as the revenue CAGR from the fiscal year before IPO until 2018. We winsorize both variables at the 10th and 90th percentiles.

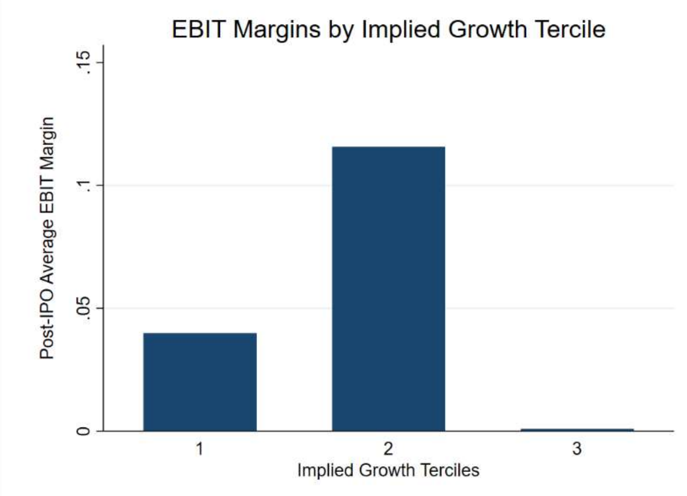


Figure 30: Cross-sectional means of average post-IPO EBIT margins, by implied growth tercile, including financial firms. We measure average post-IPO EBIT margins for each high-growth IPO firm from the fiscal year of IPO until 2018. Then, we take cross-sectional means by implied growth tercile. We measure implied growth as the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). We winsorize implied expected revenue growth at the 10th and 90th percentiles.

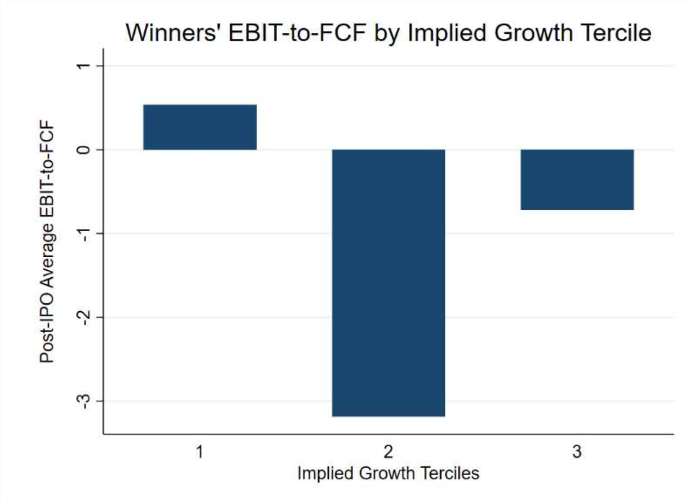


Figure 31: Cross-sectional means of average post-IPO EBIT-to-FCF conversion ratios, by implied growth tercile, including financial firms. “Winners” refers to firms whose average post-IPO EBIT margin was greater than zero. We made this distinction to facilitate the interpretation of EBIT-to-FCF. We measure average post-IPO EBIT-to-FCF ratios for each high-growth IPO firm from the fiscal year of IPO until 2018. Then, we take cross-sectional means by implied growth tercile. We measure implied growth as the revenue growth rate which satisfies the IPO offer price (see Section 3.2 for more detail). We winsorize implied expected revenue growth at the 10^{th} and 90^{th} percentiles.

Appendix 3

Underpricing’s relationship to implied growth and pre-IPO revenue CAGR.

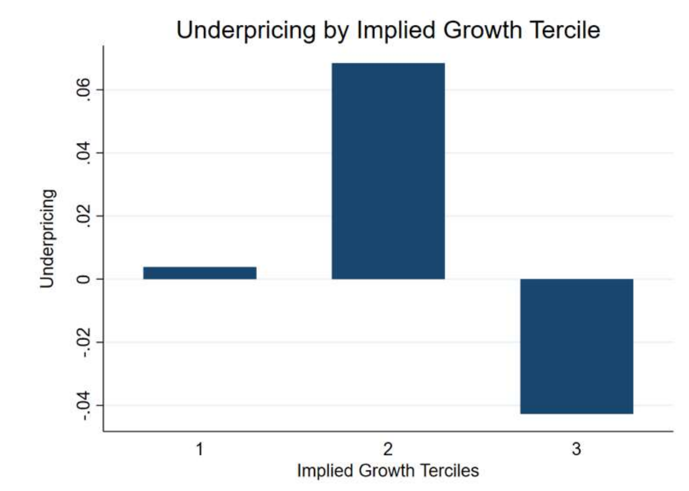


Figure 32: Average underpricing by implied growth tercile, excluding financial firms. We measure underpricing as the intraday return on the date of IPO. As elsewhere in our thesis, implied growth is the revenue growth rate which satisfies the offer price, based on the valuation methodology detailed in Section 3.2. We winsorize both variables at the 10^{th} and 90^{th} percentiles.

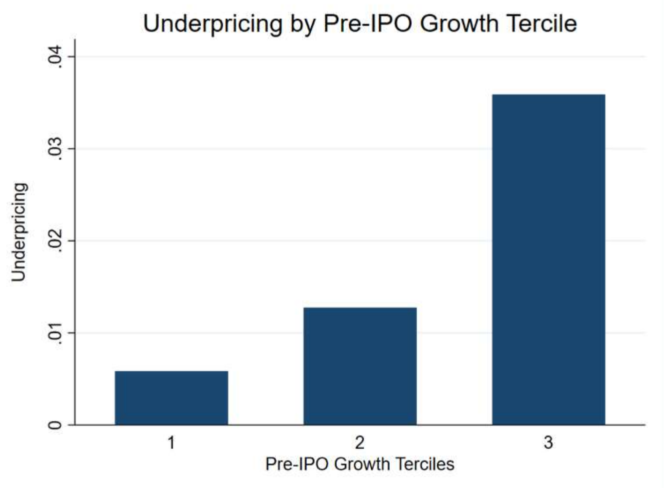


Figure 33: Average underpricing by pre-IPO growth tercile, excluding financial firms. Underpricing by Implied Growth Tercile, excluding financial firms. We measure underpricing as the intraday return on the date of IPO. We measure pre-IPO growth as the revenue CAGR of each IPO firm during the 5-year window prior to its IPO. We winsorize both variables at the 10^{th} and 90^{th} percentiles.

Appendix 4

Data for financial high-growth IPOs and their peers.

TICKER:	MANGS.ST	EABG.HE	PEGROpref.ST
Implied Growth	0.0096	-0.0230	0.9432
Post-IPO Revenue CAGR	0.0683	0.2279	2.1578
Pre-IPO Revenue CAGR	0.5050	0.5100	1.0957
Pre-IPO Revenue CAGR period (years)	1	1	1
IPO Year	2012	2015	2015
First Trading Date	7/12/2012	11/30/2015	6/24/2015
Monthly Long-Term Abnormal Return	0.0228	-0.0042	0.0038
Annualized Long-Term Abnormal Retur	0.3109	-0.0490	0.0470
β_{MKT}	0.8409	0.3618	0.2188
β_{SMB}	0.9429	-0.9352	0.2800
β_{HML}	-1.1080	-0.4451	-0.6863
β_{RMW}	-1.1223	-0.6215	-0.6537
Fama French Alpha p-value	0.1150	0.8250	0.3084
Fama French R^2	0.1155	0.2081	0.6651
1st Day Abnormal Return	0.2693		0.0057
Underpricing	0.2560	-0.1173	0.0099
1st Day Open	89.9461	5.8073	101.0000
1st Day Close	112.9758	5.1264	102.0000
Ln(B/M)	-0.2524	0.1003	-2.8907
Ln(Sales)	11.3006	11.3240	8.8005
EBIT Margin	0.0840	0.0499	-0.7884
Profit Margin Assumption	0.1549	0.3983	0.0929
Average Post-IPO Profit Margin	0.0698	0.0147	-0.0056
NI to CFE Assumption	0.3304	0.8000	0.7800
Average Post-IPO NI to CFE	0.4599	-0.0428	56.9597
D/E Assumption	-2.2078	0.2174	0.0799
Average Post-IPO D/E	-2.5505	0.2552	-0.0451
Sector	Diversified Investment Services	Investment Management & Fund Operators	Investment Management & Fund Operators

Table 24: Regression and valuation variables for financial firms. We derive implied growth as the revenue growth rate that satisfies the IPO offer price, as detailed in Section 3.2. We measure post-IPO revenue CAGR from the fiscal year prior to IPO until 2018. We measure pre-IPO revenue CAGR over the 5-year window prior to each IPO date. We also report the number of periods available to compute CAGRs. We estimate monthly long-term abnormal returns as the intercept from time-series regressions of high-growth IPO returns in excess of the risk-free rate on MKT, SMB, HML and RMW, using monthly European Fama French 5 Factor data from the Kenneth French website (see Section 3.5 for detailed steps for estimation). We report additional information from these regressions: annualized long-term abnormal returns; the coefficients on MKT, SMB, HML, and RMW (β_{MKT}, β_{SMB}, β_{HML}, and β_{RMW}, respectively); the p-value of the intercept (Fama French alpha p-value); and the R^2 (Fama French R^2). We measure 1st day abnormal returns as the 1st day return of each IPO, net of the market and risk-free rate returns at the date of IPO, using daily Fama French European 5 Factor data from the Kenneth French website. We measure underpricing as the intraday return on IPO day. 1st day open and 1st day close are the intraday price observations for each IPO. We measure Ln(B/M) as the natural log of total common book equity in the year prior to IPO, divided by market capitalization at 1st day close (further details about the computation of this variable are found in Appendix 5). Ln(Sales) is the natural log of sales in the year prior to IPO. We measure EBIT margin in the fiscal year prior to IPO. Variables ending with the label "Assumption" are the median of peers' average ratios during the 10-year window prior to IPO (see Sections 3.2.2-3.2.3 for greater detail). We measure average post-IPO ratios for each high-growth firm from the year of IPO until 2018. Profit margin is equal to net income divided by revenue, and NI to CFE measures the conversion of net income into equity cash flow. Sector corresponds to the industry segment reported in Eikon.

Peer Ticker	IPO Ticker	β_{MKT}	Average D/E	Rd	Re	Ru	Profit Margin	NI to CFE
ARDN.L	MANGS.ST	1.0055	-1.0879	0.0192	0.0753	-0.6191	0.0743	-0.1609
JIM.L	MANGS.ST	0.2018	-3.3276	0.0192	0.0311	0.0141	0.2355	0.8217
CAGGK.H	EABG.HE	1.2096	0.1238	0.0050	0.1809	0.1615	2.2226	1.1935
LUXORb.CO	EABG.HE	0.1868	1.6018	0.0069	0.0786	0.0345	0.4444	1.7568
MLPG.DE	EABG.HE	0.3727	0.3109	0.0050	0.0972	0.0753	0.1544	1.0461
VZN.S	EABG.HE	0.4580	-2.8506	-0.0007	0.1057	-0.0582	0.3523	0.0727
CAPMAN.HE	PEGROpref.ST	0.4951	0.0799	0.0072	0.0472	0.0443	0.1773	1.5935
MBBG.DE	PEGROpref.ST	-0.5412	-0.0299	0.0050	-0.0098	-0.0102	0.0513	0.2270
RATOb.ST	PEGROpref.ST	0.9736	0.4945	0.0072	0.0735	0.0516	0.0929	0.9817

Table 25: Ratios for peers of financial firms. We utilize these ratios to value the IPOs in our sample, as we indicated in Sections 3.2.1, 3.2.2, 3.2.4, and 3.3. IPO Ticker identifies the corresponding IPO firm in our sample. β_{MKT} is the market beta of peer firms (we base our estimation on monthly Fama French developed countries 5 factor data from the Kenneth French website). The period for these regressions is May 2010 to the date of IPO for the corresponding high-growth firm. We measure average D/E over the 10-year window prior to the IPO date of the corresponding high-growth firm. Rd, profit margin, and NI to CFE are averages computed over the same 10-year window. Rd measures implied cost of debt, which we estimate as interest expense divided by the 1-year lag of net debt (further detail is given in Appendix 5). Re is equal to the sum of the annualized historical average of the risk-free rate and the product of β_{MKT} with the annualized historical average of MKT, subject to the constraints given in Section 3.2.3. We measure historical averages as of each IPO date. We compute Ru as in Section 3.2.3. Profit Margin is equal to the average of net income divided by revenue. Net Income to CFE measures the average conversion of net income to equity cash flow, where the latter is computed as in Section 3.3.

Appendix 5

This appendix presents an analysis of the different cases that can be present in our data and how these are dealt with to construct the variables we use. We divide the analysis into sections based on the different stages of our methodology. We have done most of this analysis using case matrices. The subscript *t* is used to indicate the current period.

1st Day Abnormal Return Regression Controls

Ln(B/M)

Natural log of book equity divided by common shares outstanding times share price, where we take book equity and common shares outstanding from the most recent annual report data prior to the IPO, and the share price is the closing price on the day of the IPO. Our calculation algorithm is to only calculate when both book equity and market capitalization are positive and non-missing values. Otherwise the ratio is set to a missing value.

Ratios – Peers and High-Growth Firm Post-IPO Period

D/E_t

Book Equity $_t$	**Net Debt $_t$**		
	Missing	***≤ 0***	***> 0***
Missing	IGNORE	IGNORE	IGNORE
≤ 0	IGNORE	IGNORE	IGNORE
> 0	IGNORE	COMPUTE	COMPUTE

Implied Cost of Debt $_t$

Interest expense $_t$	**Net Debt $_{t-1}$**		
	Missing	***≤ 0***	***> 0***
Missing	IGNORE	IGNORE	IGNORE
≤ 0	IGNORE	IGNORE	IGNORE
> 0	IGNORE	IGNORE	COMPUTE – interest expense $_t$ / net debt $_{t-1}$

Components of FCF for IPOs and Peers

YoY changes – all variables for which YoY changes are computed

X_{t-1}	**X_t**	
	Missing	***Not Missing***
Missing	IGNORE	COMPUTE CHANGE
Not Missing	COMPUTE CHANGE	COMPUTE CHANGE

Goodwill Investment $_t$

Delta Goodwill $_t$:

Goodwill $_{t-1}$	**Goodwill $_t$**	
	Missing	***Not Missing***
Missing	IGNORE	COMPUTE CHANGE
Not Missing	IGNORE – it is likely a write-off	COMPUTE CHANGE. Note, negative Goodwill is a cash saving.

Delta Accumulated Amortization $_t$:

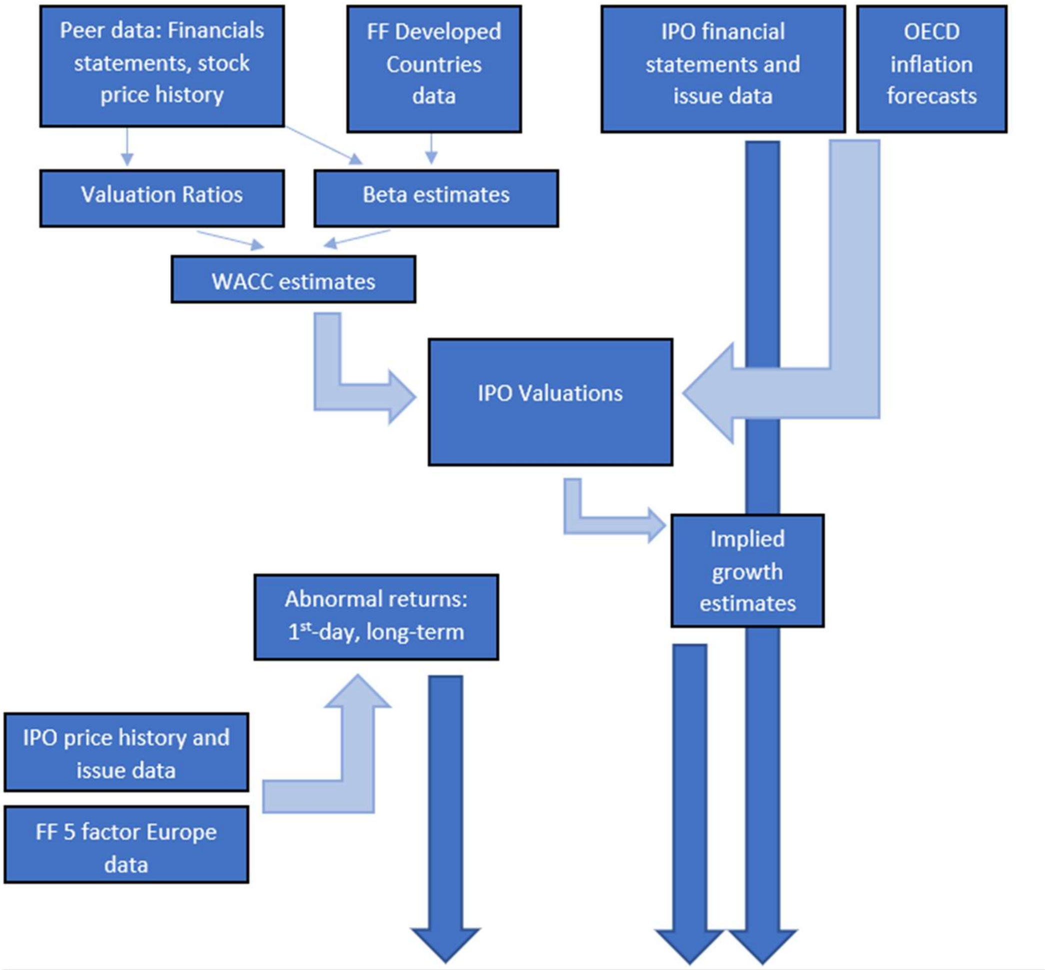
Accumulated Amortization $_{t-1}$	**Accumulated Amortization $_t$**	
	Missing	***Not Missing***
Missing	IGNORE	COMPUTE CHANGE
Not Missing	IGNORE – it is likely a write-off	COMPUTE CHANGE

Goodwill Investment $_t$:

Delta Accumulated Amortization $_t$	**Delta Goodwill $_t$**		
	Missing	***≤ 0***	***> 0***
Missing	IGNORE BOTH	IGNORE BOTH – it is likely a write off	SUM THE TWO – it is likely an investment
≤ 0	IGNORE BOTH – it is likely a write off	IGNORE BOTH – it is likely a write off	SUBRACT Delta Accumulated Amortization $_t$ from Delta Goodwill $_t$. There was likely an investment and a write-off that dominates amortization. As that is a non-cash deduction, adjust by taking the indicated difference.
> 0	IGNORE BOTH – Amortization is a non-cash item	SUM THE TWO – it is likely an investment	SUM THE TWO – it is likely an investment

Appendix 6

Methodology flow diagram.



Regressions	
Implied growth on realized growth Abnormal long-run return on implied growth Abnormal long-run return on post-IPO revenue growth Abnormal 1st day return on implied growth Abnormal 1st day return on pre-IPO revenue growth	Implied growth on realized growth Assumed EBIT margin on realized EBIT margin Assumed EBIT/FCF on realized EBIT/FCF Assumed D/E on realized D/E Assumed implied cost of debt on realized implied cost of debt

Figure 34: Methodology flow diagram. This corresponds to the methodology outlined in Section 3.

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