Underpricing of Initial Public Offerings in the Service Industry and the Importance of SIC Credit Ratings

Evidence from the NASDAQ

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Abstract

This paper reconsiders the empirical analysis that the underpricing of IPOs increases with ex-ante uncertainty, using a sample of 312 IPOs on the NASDAQ in the service industry from the period 2001-2017. Two additional variables, based on credit ratings, are added to the existing proxies for ex-ante uncertainty. The most notable finding is that SIC code credit ratings, which have not been tested before, give significant results to decreasing ex-ante uncertainty and therefore lower underpricing. Underwriter prestige, however, suggests a contradicted significant positive result to existing literature for underpricing. Other variables as firm age, offer price and CUSIP code credit ratings generate coefficients in line with previous, however insignificant. The standard deviation of aftermarket returns, firm size and gross proceeds show contradicted results towards earlier research.

Keywords: Initial Public Offerings, underpricing, ex-ante uncertainty, credit ratings

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1. Introduction

Over the past few decades Initial Public Offerings (IPO) was one of the biggest tools for companies to raise money. Just in the United States 180 companies went to the public market in 2017 with estimated total proceeds of around 31.4 billion dollars (Renaissance Capital, 2018). Despite the underpricing that is found in several studies and many alternatives for acquiring money, still a great amount of firms use an IPO to raise capital. There are several reasons why IPOs are given the priority. At first it is a very easy way to reach many investors who are willing to pay for shares for your company. Another reason could be that (small firm) managers want to increase public awareness of the company, which could lead to an increase in market share. Also, founding individuals/venture capitalists used IPOs as an exit strategy. This states that founders (or venture capitalists) make use of an IPO to cash in on the successful business they started-up (Nelson, 2003)

The topic IPO is much debated in the United States, since several large firms have undergone high underpricing and therefore left high amounts of money on the table. LinkedIn in 2014 is a great example for this phenomenon. When the firm decided to raise money through an IPO, it offered a share price of $45. However, its share price closed at €92.25 per share that same day (SOLOMON, 2011). This resulted in a 'loss' of $175 million on the first day of trading, and some experts argued that this extreme underpricing could be prevented. Short term underpricing of 105% seems not to be uncommon, and underpricing is therefore still an issue among firms. Professors have found that IPO underpricing is ubiquitous. Ritter (2009) documented an average first day return of 14.8% from 1990 to1998 and 12.8% from 2001 to 2009 in the United States.

The majority of the vast amount of existing literature focused on the performance of IPOs. The general consensus among the academic literature is that IPOs will have high average first day initial returns. However, there is no general consensus about what factors cause these underpricing in the short run. Several researchers suggest different proxies for ex-ante and ex-post uncertainty as a cause for the short-term effects on IPOs. Beatty and Ritter (1986) were one of the first researchers who came up with ex-post uncertainty as an explanation for the underpricing of IPOs. The results indicated that the standard deviation of returns in the aftermarket, a proxy for ex-post uncertainty, was correlated with underpricing, which corresponded with Rock's (1986) theory about IPO underpricing. This theory stated that information asymmetry between informed and uninformed investors are an explanation for IPO underpricing. Other previous studies also base their evidence on industry effects that may impact

performance of an IPO, however not primarily focusing on one industry (Pollock and Rindova, 2003; Welbourne and Andrews, 1996).

Alternative proxies for ex-ante uncertainty like firm size, firm age, issue gross proceeds and underwriter prestige also seem to have an impact on the underpricing performance of IPOs. All these findings are important for both the scientific world but also for practitioners such as the top management of issuers and investment banks. For this reason, factors related to ex-ante uncertainty will be discussed and researched thoroughly.

Therefore, the research question in this paper is as follows:

"Which ex-ante uncertainty factors have an impact on the average first day initial returns of initial public offerings in the service industry on the NASDAQ?"

Ex-ante uncertainty proxies related to underpricing of IPOs have not been examined primarily before in the service industry (SIC code 70-89) in the United States. Therefore, this research examines a sample from Initial Public Offerings on the NASDAQ from 12/31/2000 to 12/31/2017 in the service industry. The proxies used to measure the correlation between IPO underpricing and ex-ante uncertainty are based on earlier research and adds the importance of SIC code and CUSIP code credit ratings to expand recent empirical literature.

The main finding of this study shows a significant negative relationship between SIC code credit ratings and ex-ante uncertainty. Underwriter prestige also seem to play a role in explaining IPO underpricing, however not all results are significant. Firm age, offer price and CUSIP credit ratings present negative coefficients to average initial returns, which are in line with previous studies. However, the standard deviation of aftermarket returns and firm size show an opposite relationship to initial returns compared to earlier research. Finally, gross proceeds show different results in the univariate and multivariate analysis.

The remaining of this paper is structured as follows. It continues in section two with a review of the relevant literature on the level of underpricing of IPOs in the short run and its factors that cause this effect. Section three will elaborate on the data and methodology used. Subsequently, the results from the empirical analysis will be presented. Finally, this paper ends with a summary and conclusion in which the findings will be discussed.

2. Theoretical background and relevant literature

2.1 Initial Public Offerings performance

The effects of Initial Public Offerings on share prices are a widely discussed topic in the finance world. Previous studies have been focusing on the short-term effects on IPO share prices and discovered evidence about why firms are being underpriced.

Most literature defines underpricing as the negative difference between the share price a firm offers when it enters the market and the share price at the end of the first day of trading. This is called the average first day initial return. Not all researchers agree on which factors are main drivers for underpricing, however almost all agree on the fact that underpricing in general does exist.

As mentioned before, there consists a general consensus in earlier research about the existence of underpricing of IPOs in countries. Firms will generally identify a high average short-term return. This phenomenon is noticed in different countries and time horizons. Recently, a study revealed the presence of underpricing in the period 2011-2016 on the Dhaka Stock Exchange. Researchers found underpricing, as the average first day return was 22% (Sochi and Islam, 2018). A research in India revealed similar results, with average first day initial returns of 22% in the period 2005-2015 (Dhamija and Arora, 2017). Moreover, three decades ago Wasserfallen and Wittleder (1994) found positive results according to the underpricing phenomenon in Germany after the first day of trading. So, earlier literature suggests that underpricing exists in different countries and different periods.

2.2 Ex-ante uncertainty effect

The importance of ex-ante uncertainty is a widely discussed topic in explaining positive average first day returns of IPOs. This subject is debated in two ways. Firstly, several studies argue if ex-ante uncertainty itself plays an important role in explaining underpricing. Secondly, researchers question which proxies are appropriate for measuring ex-ante uncertainty. Above that, studies reveal different significant results of several proxies on underpricing.

2.2.1 Market-based risk measure

One of the first proxies used to measure uncertainty is the standard deviation of returns measured from a period after the first trading day. This proxy provides similar conclusions in several papers, however it should be seen as an ex-post proxy as data is obtained after a firm goes public. Wasserfallen and Wittleder (1994) found significant results regarding the positive relationship between the standard deviation of returns over the first 22 trading days in the secondary market and the average first day return. The results indicated that underpricing is related to ex-post uncertainty in Germany in the period 1962-1987. Clarkson and Merkley (1994) also examined the effect of the standard deviation on returns, however they used an estimation period of 59 days. This study on the Toronto Stock Exchange from 1984-1987 revealed the same conclusion as Wasserfallen and Wittleder (1994), proving that the standard deviation of returns is significantly positively related to underpricing. More positive significant results were acquired from the NASDAQ National Market in the period 1991-1995. Corwin and Harris (2001) used an estimation window of five-day close-to-close returns over the first 100 trading days. In accordance to earlier research they found the same significant positive relationship with the aftermarket standard deviation of returns and underpricing. Similar conclusions may be drawn regarding earlier literature regardless of the estimation window of the aftermarket standard deviation of returns (McGuinness, 1992; Finn and Higham, 1988).

2.2.2 IPO offer characteristics

Another broadly discussed factor that measures ex-ante uncertainty to explain underpricing is the inverse gross proceeds, also indicated as IPO size or issue size. The gross proceeds are calculated as the offer price times the total amount of common shares offered. However, mixed conclusions are provided in previous studies about underpricing when the inverse of gross proceeds increases. More than three decades ago Beatty and Ritter (1986) were one of the first researchers who examined this phenomenon as the empirical regularity that smaller offerings are more speculative than larger offerings (Ritter 1985) on IPOs. They examined IPO underpricing on firms registered on the SEC between 1977 and 1982. The results of this study revealed that the coefficient of the inverse of gross proceeds is 83,578 on initial returns, meaning that smaller offerings, ceteris paribus, have substantially higher average initial returns. Carter, Dark, and Singh (1998), Dunbar (2000), Jain and Kini (2000) acquire similar results about larger IPOs, in terms of the number of shares and the offer price. Larger IPOs would normally be offered by well-known firms, which should reduce the perceived risk of the offering. Although it seems that many papers provide similar results about underpricing and issue size, some papers however find an opposite relationship between underpricing and the inverse of gross proceeds. Daily, Trevis Certo, Dalton, and

Roengpitya, (2003) tested the hypothesis that underpricing is positively correlated with the inverse of the issue size, however the results provided an opposite relationship. Based on their results the ability to help to understand the ex-ante uncertainty phenomenon is modest when reviewing gross proceeds. Other empirical evidence from Jain and Kini (1994) provides comparable conclusions as they find a significantly positively relationship with offering size when a company enters the market and its performance. Although it seems that different findings are given, the majority seems to conclude that gross proceeds are negatively related to IPO average first day returns.

The initial offer price of an IPO may also have an impact on the level of underpricing. Before an IPO enters the market, the lead underwriting firm is responsible for acquiring and evaluating information about the aggregate pre-market demand for its client's prospectus in an attempt to set an offer price. Previous research investigates the value of the price set at an offer with the level of underpricing. Supposedly, a very modest offer price will indicate low demand, low value, or both (Jain and Kini, 1999a). Interestingly, however, Ibbotson, Sindelar, and Ritter (1988) suggest that companies with abnormally low offer prices (offer price below $3) undergo very high levels of underpricing. Several other studies also state that a company face a higher degree of uncertainty when it sets its offer price at a lower level (Aggarwal, Prabhala and Puri, 2002; Brav, Geczy, and Gompers, 2000). Accordingly to most literature, it seems mainly that the offer price is negatively correlated to underpricing.

2.2.3 Firm characteristics

The age of a firm is a firm characteristic that has served as a surrogate for risk in previous IPO literature. Earlier research interpreted more established firms as less risky (Ritter. 1984; Carter, Dark and Singh, 1998). Firms with fewer years of existence have fewer published financial reports and are less likely to have been reviewed by financial experts (Rasheed, Datta, and Chinta, 1997). The general consensus among the existing literature adds the importance of the relationship between firm age and underpricing, as the level ex-ante uncertainty decreases with older, more established firms (Megginson and Weiss, 1991; Mikkelson, Partch, and Shah, 1997; Ritter, 1998; Carter and Manaster, 1990)

Firm size is another firm characteristic tested in various empirical studies serving as a proxy for ex-ante uncertainty. This variable is also examined as a firm's total assets. Larger well-known firms present less uncertainty for potential investors in comparison to small businesses. For example, larger corporations have greater access to resources necessary for profitability and survival (Finkle, 1998). Another possible

explanation for this phenomenon is that larger businesses may attract more prestigious and successful investment banks for an IPO (Carter, Dark, and Singh, 1998). Smaller businesses may also be identified as offering lower earnings potential, leading prominent underwriters to evade these IPOs so that they avoid the risk of losing high amounts of capital through undersubscribed issues. Underwriters intend to retain their clients and therefore they will also be afraid to pass on riskier issues, so they will not jeopardize prospective clients. Consistent with these findings, diverse research concluded a negative association between underpricing and firm size (Carter, Dark, and Singh, 1998; Ibbotson, Sindelar, and Ritter, 1988; Ibbotson, Sindelar, and Ritter, 1994; Megginson and Weiss, 1991).

2.2.4 Reputational characteristics

The quality of an underwriter may also be a factor that influences the performance of an IPO. Underwriters with a high reputation might signal less uncertainty surrounding the IPO thereby improving IPO firm performance (e.g. reducing underpricing) (Carter, Dark, and Singh, 1998; Carter and Manaster, 1990; Lange et al., 2001; Megginson and Weiss, 1991). The idea behind this is the prior experience in taking companies public and the reputation the prestigious investment bankers have as an effective underwriter to protect companies from large mispricing. Prior experience and reputation function therefore as a signal to potential investors that the underwriters are aiming for a success of the IPO, both in the short run and long run. On the other hand, underwriters have opposite goals about the IPO performance and therefore the relationship with underwriter quality and underpricing is not straightforward. IPO underwriters have two clients with the opposite targets regarding the price of an IPO. The first client is the firm whose securities are sold through the underwriter on the market. The second constituents are the institutional investors to whom the underwriters market the IPO shares. The vast amount of IPO securities are not directly sold on the open exchange markets, but initially traded first to important clients of the investment banker. These different types of organizations will aim for different purposes concerning performance indicators as underpricing of the IPO. The initial shareholders of the IPO business desire a low degree of underpricing, as it shows money left on the table. Underwriter's institutional investors, on the other hand, generally raise more money with higher levels of underpricing with the IPO firm. The underwriter's relationship with their institutional client base also differs from the IPO companies, as they maintain contact after the issuing of the securities. Previous empirical research concludes that IPO firms are unlikely to have the same underwriter for seasoned equity offerings as they had with their first issuing of shares (Spiess and Pettway, 1997). This finding suggests that underwriter reputation is positively related to the level underpricing (Beatty and Welch, 1996). Several researchers examine the relationship between underpricing and the quality of the underwriter. The majority of the

existing literature finds support for the negative association of underwriter prestige and underpricing (Beatty and Ritter, 1986; Carter, Dark, and Singh, 1998; Carter and Manaster, 1990; Johnson and Miller, 1988). Logue (1973), for example, found a difference between prestigious underwriters and non-prestigious underwriters, as the first group represented an average significant underpricing of 21% and the following group 52%. Based on the existing research is therefore interesting to examine the effect of underwriter reputation on the IPO average first day return.

A not so briefly discussed factor in previous research is the outcome of credit ratings on underpricing. Credit ratings could be a factor that decreases the ex-ante uncertainty as it serves historic business information based on a grade given by well-known credit rating agencies. Faulkender and Petersen (2006) show the effect of information asymmetry, between a company and the public market, on raising debt with credit ratings. They find that public firms with credit ratings are more able raise debt than firms without a rating. Another study by Liu and Malatesta (2006) concludes that credit ratings facilitate companies' seasoned equity offerings (SEO). This research states that firms with credit ratings are underpriced significantly less than those without credit ratings when issuing shares. One research, however, examines the effect of credit ratings and the impact on IPO performance. An and Chan (2008) show that when companies go public, those with credit ratings undergo significantly less underpricing than firms without credit ratings.

2.5 Hypotheses development

To give an answer on the research question a set of hypotheses will be created. The research questions is as follows:

"Which ex-ante and ex-post uncertainty factors have an impact on the average first day returns of initial public offerings in the US?"

The hypotheses will be categorized in four different groups with each containing ex-ante uncertainty variable. First, the market-based risk measure in this research contains the standard deviations of returns in the aftermarket. According to previous studies the following hypothesis is developed:

H1: The standard deviation of returns in the aftermarket is positively related to underpricing.

Also, IPO offering characteristics are examined in this paper to test the relevance of ex-ante uncertainty. This category contains the inverse of gross proceeds and the offer price related to the average first day returns. These factors have similar outcomes based on earlier research and therefore one hypothesis is developed:

H2: IPO offering factors are negatively associated with underpricing.

Besides IPO specific factors, this study also focuses on the association of firm specific factors with IPO performances. Firm size and firm age are firm specific factors studied in previous research with similar conclusions about its effect. For this reason, one hypothesis is created in this category:

H3: Firm characteristics are negatively related to underpricing.

The fourth category contains two different types of reputational factors. First, the indirect reputational factor is measured by examining the effect of the underwriter quality on underpricing. The direct reputational factors are analysed by two different types of credit ratings. Firm specific credit ratings and SIC code specific credit ratings are proxies to test the relationship of direct reputational factors with the level of underpricing. Since all reputational factors appear to have congruent effects on underpricing according to previous studies, the following hypothesis is developed:

H4: Reputational characteristics are negatively associated with underpricing.

3. Data and methodology

3.1 Data

Data about IPOs in the service industry in the United States is used from 2000 until 2017. Thomson One's database will be used to collect information about the IPOs and Compustat to find credit ratings of the corresponding shares. The criteria for the sample selection is as follows:

Table 1 Remaining IPOs after selection criteria

Criteria	Description	Remaining IPOs after applying the criteria
Type of raising capital:	Initial Public Offering	82185
Exchange market:	NASDAQ (United States)	20378
SIC code:	Services	6711
Period:	12-31-2000 until 12-31-2017	1841
Type of shares:	Common shares	1177
Market:	Filtered out already listed shares	1175
Offer price:	Missing data about offer prices and filtered out prices equal to 0	689
Bookrunners:	Missing data about bookrunners	684
Company type:	Filtered out investment, real estate and participation companies	650
CUSIP and ISIN codes:	Missing data about codes	471
Duplicates:	Filtered out	395
Firm size:	Total assets before IPO	322
Firm age:	Years of existence	321
Aftermarket data:	Missing aftermarket data	312
CUSIP credit rating	**Company rating**	**42**
SIC credit rating	**Industry rating**	**269**

Only common shares will be selected in this research to prevent that preferred shares will be included in the data set. Preferred shares are characterised with privileges and therefore show a different price trend that will result in problems for providing conclusions about underpricing. Shares that were already listed on other stock exchange markets will also be excluded from the data. The price of these shares is already known on other exchange markets, so underpricing will not be an issue here (Wasserfallen and Wittleder, 1994). Investment, real estate and participation companies are filtered out of the sample because their net asset value is already known. The net asset value of these organisations shows the intrinsic value of the shares, which will not result in underpricing when going public (Carter and Manaster, 1990). Several data besides about CUSIP codes, ISIN codes, bookrunners, the aftermarket, offer size, firm size, firm age is missing and these shares are therefore not included in the sample to prevent that wrong conclusions may be drawn. The sample is divided into two groups, after applying the criteria, to test the effect of SIC code and CUSIP code credit ratings. The SIC code group on the one hand is examined to test ex-ante uncertainty based on industry ratings. The CUSIP code group is, on the other hand, evaluated to test ex-ante uncertainty based on company credit ratings. These ratings vary from AA (excellent) to CCC (extreme weak) and predict the firm's ability to pay back a long-term debt. This also provides extra information about its performance (based on industry or firm) before a firm goes public. Finally, two duplicates have been removed from the sample.

The companies' Datastream codes collected from Thomson One's database were used to retrieve stock prices and share returns from Datastream. The returns and stock prices from Datastream are collected from the first day of trading until 21 days after the listing. The sample is limited to 312 shares after eliminating missing aftermarket data.

The descriptive statistics of all variables, used as a proxy for ex-ante uncertainty in this research, are provided in Table 2. The proxies stated in Table 2 have been suggested to have a relationship with ex-ante uncertainty with an overview of the relationship with underpricing presented in Table 3 according to previous studies. The variables are defined as follows:

Market based risk measure:

SDOR Standard deviation of daily returns measured over the first 20 days subsequent to the first day of trading.

IPO characteristics:

GP Gross proceeds in million dollars from the offer.

OFF Offer price in dollars.

Firm characteristics:

SIZE Total assets in million dollars on balance before initial public offering.

AGE Number of years of operating history.

Reputational characteristics:

UWP[1] Underwriter prestige variable with a value of 1 if underwriter is designated as high prestige and 0 if not.

SIC SIC (industry) code credit rating variable with a value of 1 if rating is known and 0 if unknown.

CUSIP CUSIP (company) credit rating variable with a value of 1 if rating is known and 0 if unknown.

[1] Underwriter prestige is based on the rank of tombstone placements.

Table 2 Descriptive statistics

This table gives the descriptive statistics about the variables used in this study.

Variable	Obs.	Mean	Standard Deviation	Median	Min.	Max.
IR	312	0.17	0.47	0.08	-0.92	4.02
NASDAQ	312	0.00	0.01	0.00	-0.05	0.09
SDOR	312	0.04	0.02	0.03	0	0.13
AGE	312	12.63	15.37	8	0	120
SIZE	312	340.77	1752.39	63	0.2	28866.10
GP	312	119.59	133.32	82.8	5.28	1293.75
OFF	312	12.82	4.54	13	4	27
UWP	312	0.62	0.49	1	0	1
CUSIP	312	0.13	0.33	0	0	1
SIC	312	0.84	0.37	1	0	1

Table 2 shows an average initial return of 17% of all 312 observations and a median of 8% with a standard deviation of 47%. The last two columns show that the sample consists of large under- and overpricing of 402% and 92% respectively. Variables as GP and SIZE show large differences between their mean and median, which indicates that these variables contain a skewed distribution.

Table 3 Expected versus estimated relationship versus with ex-ante uncertainty

This table shows the sign of the relationship of the proxies with the average initial returns from previous studies (expected) and if the proxy increases or decreases ex-ante uncertainty according to previous studies.

Category	**Variable**	**Expected relationship**	**Increase/decrease ex-ante (or ex-post) uncertainty**
Market-based risk measure (ex-post)	Standard deviation of returns	+	Increases
Firm characteristics	Firm Age	-	Decreases
	Firm Size	-	Decreases
IPO offer characteristics	Gross Proceeds	+	Increases
	Offer price	-	Decreases
Reputational characteristics	Underwriter quality	-	Decreases
	SIC code credit ratings	-	Decreases
	CUSIP code credit ratings	-	Decreases

3.2 Methodology

3.2.1 Initial return

To calculate average first day returns the initial returns will be calculated. The formula is as follows:

$$IR_i = \frac{CP_i - OP_i}{OP_i} \times 100\%$$

IR_i is the initial return of firm's i share, measured as the difference between the day closing price (CP_i) and the day opening price (OP_i) divided by the day opening price of share i. The average first day initial returns are calculated to measure underpricing of the various variables. The initial returns of the following 20 days after the first trading day will also be used to calculate the standard deviation of return (SDOR).

3.2.2 Cross-sectional univariate analysis

Cross-sectional regressions will be used to measure the effect of the ex-ante uncertainty proxies on the initial returns.

First, univariate regressions are performed of all different variables on the first day initial returns to measure which variables play an important role in explaining short term underpricing. To estimate the standard deviation of returns, the returns of the first 20 days of trading after an IPO is listed are used. This means that the first day initial return is not accounted in the regression for these two variables. In the following univariate regressions, the initial return is the dependent variable and the factors mentioned in section 3.1 are the independent variables. The variables are subsequently divided into subsamples, with the median as an indicator of the split between the groups, to compare the average underpricing between those two groups:

$$IRi = \alpha + \beta i * Factori + \varepsilon$$

Where:

i = Proxy variable

α = Constant

β = Sensitivity to change of proxy variable i

$Factori$ = Value 1 if proxy is high ex-ante uncertainty subsample and 0 if low ex-ante uncertainty subsample

ε = Error term

3.2.3 Significance test

t-tests are then performed for calculating the differences of the initial returns between the higher and lower subsamples of the ex-ante uncertainty proxies. These tests are shown in Table 3. The null hypothesis for this test states that the average initial returns of the subsamples are equal:

$$H_0: \mu_{low} = \mu_{high}$$

$$H_1: \mu_{low} \neq \mu_{high}$$

Where:

μ_{low} = Proxy mean of the lower ex-ante uncertainty subsample

μ_{high} = Proxy mean of the higher ex-ante uncertainty subsample

Then, a White's t-test can be used to determine the significance of the difference between the two subsamples. The formula for the t statistic is as follows:

$$t = \frac{x_{low} - x_{high}}{s_p \sqrt{\frac{1}{n_{low}} + \frac{1}{n_{high}}}}$$

With :

$$s_p = \sqrt{\frac{(x_{low} - 1)S_{low}^2 + (x_{high} - 1)S_{high}^2}{n_{low} + n_{high} - 2}}$$

Where:

x_{low} = Mean of lower ex-ante uncertainty subsample

x_{high} = Mean of higher ex-ante uncertainty subsample

n_{low} = Sample size of lower ex-ante uncertainty subsample

n_{high} = Sample size of higher ex-ante uncertainty subsample

s_{low} = Standard deviation of lower ex-ante uncertainty subsample

s_{high} = Standard deviation of higher ex-ante uncertainty subsample

s_p = Pooled standard deviation

3.2.4 Correlation matrix

A correlation matrix for the average first day initial returns and the proxies for ex-ante uncertainty is created. This matrix gives more insight into the factors. It shows, whether causal or not, if the variables' initial returns have any statistical relationship. The correlations between factors are measured as follows:

$$r_{ij} = \frac{s_i s_j}{s_{ij}}$$

Where:

r_{ij}= Correlation between factor i and j

s_i = Standard deviation of returns of proxy i

s_j = Standard deviation of returns of proxy j

s_{ij} = Covariance of returns between i and j

r = 1: strong positive relationship,

r = 0: no correlation

r = -1 strong negative relationship.

3.2.5 Cross-sectional multivariate analysis

The variables used in the univariate analysis are now constructed in multiple models to draw further conclusions about the relationship of the proxies with ex-ante uncertainty. The correlation matrix presented in Appendix A shows that the initial returns of the proxies are correlated and therefore a

multivariate analysis will be constructed. All different models will be created through a multiple regression as presented below:

$$IR = \alpha + \sum \beta i + \varepsilon$$

Where

IR = Average first day initial return

α = Coefficient

$\sum \beta i$ = Sum of proxies according to model i

i = 1 for returns of proxies model 1; 2 for returns of proxies model 2; 3 for returns of proxies model 3; 4 for returns of proxies model 4

ε = Error term

The first model will contain the continuous proxies AGE, SIZE, GP and OFF, these proxies will be shown in logarithmic form for heteroskedasticity reasons. The second model consists the dummy variables UWP SIC CUSIP. The third model analyses highly correlated (more than 50%) factors SIZE, GP, OFF and UWP. The last model includes all variables (AGE, SIZE, GP and OFF in logarithmic form) examined in this research.

4. Results

This section will discuss the empirical results of this research. First, the univariate regressions of the proxies on the first day initial returns will be discussed. Second, the results of the four constructed multivariate models on the first day initial returns will be presented. By displaying the results, the hypotheses will be answered.

4.1 Results on cross-sectional univariate regression

Table 4 represents the results on the cross-section univariate regressions on first day initial returns and Table 5 shows the expected and estimated relationship with the first day initial returns of the proxies. The difference between the subsamples of SIC code credit ratings are shown to be significant at a 10% level with an initial return of 28.46% for the lower subsample and 15.25% for the higher subsample (t-value = 1.8431). This implies that companies with SIC code credit ratings before an IPO expect to have lower underpricing which is in line with the theory about decreased ex-ante uncertainty. This corresponds with hypothesis 4, based on Faulkender and Petersen (2006), who found that credit ratings decrease the level of information asymmetry. The coefficient of GP on initial returns is 15.34% for the lower subsample and 19.42% for the higher subsample, which is in line with previous studies as this indicates that underpricing is larger for companies with higher gross proceeds. AGE, OFF and CUSIP show coefficients of 19.15%, 17.54% and 17.64% for the lower subsample and 15.53%, 17.17% and 15.64% for the higher subsample respectively. This corresponds with earlier research as the level of underpricing decreases when CUSIP credit ratings are known and firm age and offer price increases. These results are however not significant. Gross proceeds, firm age, offer price and CUSIP credit ratings are therefore not strictly in line with hypotheses 2, 3 and 4. On the other hand, Table 4 presents coefficients for SDOR, SIZE and UWP of 17.27%, 13.39% and 13.56% for the lower subsample and 17.45%, 21.34% and 19.71% for the higher subsample respectively. This surprisingly does not correspond with previous research as the estimated initial returns increase when the standard deviation of aftermarket returns, firm size and underwriter prestige are higher. These results are also shown to be insignificant and therefore do not correspond with Hypotheses 1, 2, 3 and 4.

Table 4 Cross-sectional univariate regressions on the first day initial returns

This table represents the impact of the proxies on the average first day initial returns. The sample of 312 NASDAQ shares from the service industry (SIC code 70-89) is divided into a lower and higher ex-ante uncertainty subsample on the basis of each of the selected variables. The continuous variables (SDOR = standard deviation of aftermarket returns, AGE = firm age, SIZE = firm size, GP = gross proceeds, OFF = offer price) are split in half at the median value. The remaining dummy variables (UWP = underwriter prestige, SIC = SIC code credit ratings, CUSIP =

CUSIP code credit ratings) are split on the basis of the value assumed by each dichotomous proxy. t-test values show if there consists a significant difference between average initial returns between the low and high subsamples of each proxy. The given p-values are used to examine the significance of each proxy. The statistical significance 0.01, 0.05 and 0.10 is indicated by, *, **, ***, respectively.

Proxies	**Partition**	**Total firms**	**Mean**	**Standard error**	**Standard deviation**	**t-value**	**Pr(|T| > |t|)**
SDOR	< 0.0309	156	0.1727	0.0405	0.5053		
	> 0.0309	156	0.1745	0.0341	0.4257	-0.0338	0.9731
AGE	<= 8 years	158	0.1915	0.0421	0.5296		
	> 8 years	154	0.1553	0.0316	0.3921	0.6848	0.4940
SIZE	< $63 million	156	0.1339	0.0279	0.3489		
	> $63 million	156	0.2134	0.0447	0.5582	-15.086	0.1324
GP	<= $82.8 million	157	0.1534	0.0406	0.5092		
	> $82.8 million	155	0.1942	0.0337	0.4194	-0.7716	0.4409
OFF	< $13.00	150	0.1754	0.0407	0.4979		
	>= $13.00	162	0.1717	0.0343	0.4369	-0.0698	0.9444
UWP	Non-bulge bracket	119	0.1356	0.0465	0.5075		
	Bulge bracket	193	0.1971	0.0316	0.4390	-11.328	0.2582
SIC	Unknown	50	0.2846	0.0837	0.5916		
	Known	262	0.1525	0.0270	0.4368	18.431	0.0660***
CUSIP	Unknown	273	0.1764	0.0248	0.4098		
	Known	39	0.1546	0.1218	0.7605	0.2722	0.7860

Table 5 Expected versus estimated relationship versus with ex-ante uncertainty

This table shows the sign of the relationship of the tested variables with the average initial returns from previous studies (expected) and the univariate regressions (estimated).

Category	Variable	Expected relationship	Estimated univariate relationship
Market-based risk measure	Standard deviation of returns	+	-
Firm characteristics	Firm Age	-	-
	Firm Size	-	+
IPO offer characteristics	Gross Proceeds	+	+
	Offer price	-	+
Reputational characteristics	Underwriter quality	-	+
	SIC code credit ratings	-	-
	CUSIP code credit ratings	-	-

4.2 Results on multivariate regressions

The results of the constructed models through multivariate regressions are displayed in Table 6 and the expected and estimated relationship with first day initial returns are presented in Table 7. SIC shows to be significant at the 10% level of significance in model 3 and 4 with a coefficient of -13.45% (with t = -1.87) and -14.00% (with t = -1.91) respectively. This result is in line with the results reported in the cross-sectional univariate regressions. The coefficient of SIC also gives a negative value of -12.69% in model 2, however not significant. On the other hand, the results on UWP also show a significant result at 10% in model 3 with a coefficient of 10.51% (with t = 1.66) which contradicts results from previous findings. Model 2 and 4 present a positive coefficient of 5.68% and 9.94% respectively, however insignificant. These findings suggest that SIC credit ratings (SIC) decrease the level of ex-ante uncertainty and therefore underpricing. Underwriter Prestige (UWP), however, implies an opposite effect on underpricing, which indicates that underwriter prestige does not correspond to ex-ante uncertainty results from previous research. The results from AGE show negative coefficients of -4.59% and -5.33% in model

1 and 4. The variable OFF also shows negative coefficients (model 1: -6.87%, model 3: -6.62% and model 4: -7.43%) corresponding with the univariate analysis. This is in line with earlier literature that states a decrease in underpricing when firm age and offer price increase. The proxy GP however contradicts the univariate regression with negative coefficients in models 1, 3 and 4 (-1.76%, -3.29% and -5.08% respectively), although not significant. These results do not correspond with earlier studies, suggesting that gross proceeds increase the level of underpricing. SDOR and SIZE present on the other hand positive results in the multivariate analysis. SDOR gives a negative coefficient of -48.35% in model 4 and SIZE gives negative coefficients of -2.58% and -2.77% in model 1 and 4 respectively, however insignificant. These results correspond with the univariate analysis, however they contradict with earlier literature that states a decreasing level of underpricing when the standard deviation of aftermarket returns and firm size increase.

Table 6 Multivariate regressions on first day returns

This table represents four constructed multivariate regression models on the first day initial returns based on criteria mentioned in section 3.2.6. SDOR, AGE, SIZE, GP, OFF, UWP, SIC, CUSIP are the explanatory variables. The given t-values, reported in parentheses, are used to examine the significance of each proxy. The statistical significance 0.01, 0.05 and 0.10 is indicated by, *, **, ***, respectively.

Proxy	Model 1	Model 2	Model 3	Model 4
SDOR	-	-	-	-0.4835
Log(1+AGE)	-0.0459	-	-	-0.0533
	(-1.39)			(-1.61)
Log(SIZE)	0.0258	-	-	0.0277
	(1.24)			(0.228)
Log(GP)	-0.0176	-	-0.0329	-0.0508
	(-0.37)		(-0.68)	(-1.01)
Log(OFF)	-0.0687	-	-0.0662	-0.0743
	(-0.70)		(-0.69)	(-0.75)
UWP	-	0.0568	0.1051***	0.0994
		(0.98)	(1.66)	(1.55)

SIC	-	-0.1269	-0.1345***	-0.1400
		(-1.76)	(-1.87)	(-1.91)***
CUSIP	-	-0.01447	-	-0.0396
		(-0.18)		(-0.43)
Constant	0.4147**	0.2468*	0.5317*	0.6630*
	(2.19)	(3.27)	(2.69)	(2.99)
Adjusted R^2	-0.0008	0.0048	0.0095	0.0084

N = 312 observations

Table 7 Expected versus estimated relationship versus with ex-ante uncertainty

This table shows the sign of the relationship of the tested variables with the average initial returns from previous studies (expected) and the multivariate regressions (estimated).

Category	**Variable**	**Expected relationship**	**Estimated multivariate relationship**
Market-based risk measure	Standard deviation of returns	+	-
Firm characteristics	Firm Age	-	-
	Firm Size	-	+
IPO offer characteristics	Gross Proceeds	+	-
	Offer price	-	-
Reputational characteristics	Underwriter quality	-	+
	SIC code credit ratings	-	-
	CUSIP code credit ratings	-	-

4.3 Robustness

A Robustness check has been done to check for the assumption of constant variances at the cross-sectional univariate and multivariate regressions. When performing cross-sectional regressions on both univariate and multivariate with robust standard errors, the results did not indicate a violence of the assumption mentioned above.

5. Conclusion

This paper studies the impact of widely discussed ex-ante uncertainty proxies on IPO average first day initial returns. It extends the existing literature on the relationship with ex-ante uncertainty and IPO underpricing with two proxies based on SIC code and CUSIP code credit ratings by examining a sample of IPOs on the NASDAQ. This study focuses furthermore on IPOs in the service industry listed from 12/31/2000 until 12/31/2017, which has not been done primarily before. The findings show different results towards the existing literature about the impact of the examined proxies for ex-ante/post uncertainty on first day initial returns.

The results from the univariate regressions show a significant result for SIC code credit ratings on the average first day return, which indicates that SIC code credit ratings decrease underpricing and serve as a proxy for ex-ante uncertainty. This might indicate that credit rating organizations obtain more valuable information about industries (SIC) than firms (CUSIP) and therefore underpricing can be more explained by SIC credit ratings. Models 3 and 4 also improve the explanatory value of this proxy by providing significant results for SIC code credit ratings (SIC) in the multivariate analysis. On the other hand, underwriter prestige (UWP) implies to have a positive effect on underpricing. This variable shows a significant result in model 3, however this finding contradicts with previous studies. Other variables as AGE, OFF and CUSIP generated coefficients in the estimated direction in both the univariate and multivariate regressions, however insignificant. SDOR and SIZE predicted a negative and a positive relationship with the average initial returns in both the univariate and multivariate analysis. These results contradict previous studies, however they did not provide significant results. GP showed a positive relationship (corresponds with previous literature) in the univariate regression and a negative relationship in the multivariate regressions, however not significant.

The main implication of the findings is that SIC credit ratings create less ex-ante uncertainty about a firm and therefore decrease underpricing. Issuers and underwriters should take this new ex-ante uncertainty proxy into account when setting an offer price. Investors should also consider the importance of SIC credit ratings in their decision making of buying shares at an IPO. Besides, the underwriter prestige seem to have a positive effect on underpricing in contradiction to previous literature, which suggests that different conclusions may be drawn from this ex-ante uncertainty measure.

A possible limitation of this research is the method to classify underwriters as ‘high prestige’. Some have criticised the value of this measurement. Underwriters are ranked based on their amount of tombstone or prospectus placements of IPOs. This approach values an underwriter based on the amount of tombstone placements and therefore does not look at the direct performance of underwriters. Some suggest that this method measures underwriters through quantity instead of quality.

Further research could focus on other factors that may have an impact on first day initial returns. Little light is shed on factors related to behaviour of the market that may impact the level of underpricing. Also, the effect on long-term initial returns can be suggested for further research. This will show if first day initial returns are perceived as fairly priced shares or short-term misconceptions.

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