

ERASMUS UNIVERSITY ROTTERDAM
Erasmus School of Economics

Bachelor Thesis:
Economics & Business Economics

Underpricing in the IPO market: a comparison
between platforms and pipelines

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Date Final version: 25-07-2018

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Abstract

This paper aims to compare the level of underpricing in the IPO market after the first trading day, between platforms and pipelines. For 151 US IPOs per firm type during 2002-2018, the average level of underpricing for platforms and pipelines has been respectively 24.1% and 12.9%. The average level of trading volume has also been substantially higher for platforms. This research examines multiple factors that could explain the difference in underpricing between firm types. Ex-ante uncertainty, growth potential and the role of the underwriter turned out to be explanatory factors to explain the different level of underpricing between firm types.

Keywords: IPO, Underpricing, Platform, Pipeline, Ex-ante uncertainty

1. Introduction

The rise of technology giants such as Google and Amazon has been remarkable. Firms like Alibaba and Airbnb grew from zero to dominance within no time. All of these firms have the same characteristics that make them so called “platforms” with facilitating interactions between customers and suppliers as its core value. Platforms are quickly taking over the leaderboards at the expense of the incumbent pipelines. Pipelines are firms with a linear value chain model, focused on sales. Back in 2007, the only platform in the top ten largest firms by market cap was Microsoft. Currently, five out of the ten largest listed companies in the world are platforms.

Just as normal businesses, platforms also perform an initial public offering (IPO) to raise capital for further investments. Spotify has had its IPO recently with an initial return of 12.9% after the first trading day¹, whereas the IPO of Baidu was underpriced with 354%². This implies that the variability of the initial returns are extremely large at the public offering. Ritter found that IPOs had an average initial return, i.e. underpricing, of 17.9% from 1980 till 2016 after the first day of trading. It is interesting to analyze how platforms perform relative to pipelines during an IPO, given the fact that platforms are quickly gaining ground in the leaderboards by market cap. In addition, explaining how the observed differences in underpricing occurred could provide investors or potential IPO firms with helpful information. However, there is no general theory in academic literature explaining why IPOs have such a large positive return on average, which leaves much room for research.

The literature about underpricing in the IPO market is extensive and divided into empirical and theoretical studies. Tim Loughran and Jay Ritter (2002) are one of many, who did empirical research about how IPO underpricing changes over time. Beatty and Ritter (1986) & Rock (1986) did theoretical research to explain the relationship between information asymmetry and underpricing. Moreover, Jenkinson and Ljungqvist (2001) differentiated the

¹ Spotify IPO closes with over \$26B valuation in first day of public trading: <https://www.billboard.com/articles/business/8283875/spotify-ipo-stock-close-26-billion-valuation-public-trading>

² The Untold Story of the Baidu IPO: Baidu IPO <https://seekingalpha.com/article/157809-the-untold-story-of-the-baidu-ipo>

level of underpricing between industrialized countries and emerging markets. However, there is no empirical research that differentiates the level of underpricing between firm types.

This paper intends to add to the empirical literature, by expanding IPO underpricing to a comparison between firm types, i.e. platforms and pipelines, within the same dataset. This type of analysis will present new insights in how the level of underpricing differs by firm type and what factors are possible influencers of the observed difference. The paper provides investors with better information to organize their investment portfolio. Besides, it could serve potential IPO firms with information about determinants of different levels of underpricing. First, the paper aims to compare the level of underpricing between platforms and pipelines after the first trading day. Second, it tries to find explanations for the empirical findings by using logic reasoning, based on other literature and theoretical models. This leads to the following research question:

To what extent is there a difference in the level of underpricing, between platforms and pipelines, to be observed at an IPO and how to explain this difference?

The rest of the paper is organized as follows. The next chapter provides the literature review, which describes theoretical implications about underpricing and introduces the characteristics of the platform and pipeline business types. Moreover, it introduces the hypothesis that will be tested. The third chapter presents the underlying data and methodology of the research that will be used to test the hypothesis. The fourth chapter elaborates on the main results following from the analysis, divided per hypothesis. The fifth chapter provides an interpretation and discussion of the most important results. The last chapter concludes on the main results and presents an answer on the research question. It also includes limitations of the paper and recommendations for further research.

2. Literature review

2.1 Introduction IPO

An initial public offering (IPO) is the event at which a private company becomes publicly traded at the stock market for the first time (Ritter & Welch, 2002). The IPO process requires a lot of planning and costs the firm a large sum of money. However, firms take these costs for granted, because the benefits are greater. There are multiple reasons for a company to go public (Hunsaker, 2017). First, to raise capital and spread the risk of ownership over a wide group of investors. The raised money could be used for growth purposes, investments in research and development or to reduce outstanding debt. Second, an IPO creates free publicity that helps the firm to improve its name awareness among customers. At last, it signals a sense of corporate stability to the public and gives the firm status as an established business entity.

An IPO also has some disadvantages. Most importantly, it costs the company a lot of time and money throughout the process. The IPO process contains various one-time costs that can be subdivided into direct and indirect costs. First, the main direct cost is the underwriter fee. “Based on the public registration statements of 315 companies, on average, companies incur an underwriter fee equal to 4-7% of gross proceeds, plus an additional \$4.2 million of offering costs directly attributable to the IPO (PWC, 2018)”. Second, legal and accounting fees are also direct costs. At last, a public company must comply with more complicated legal requirements and regulations set forth by the SEC (US Securities & Exchange Commission, 2018). Compliance of these rules costs the firm more money. Indirect costs are effort and time that managers devote to conduct the offering. Moreover, the dilution associated with selling shares below market value are also indirect costs.

2.2 Underpricing anomaly

There is a lack of consensus about explaining anomaly considering IPOs, called IPO puzzles. This paper focuses on underpricing. A stock is underpriced if the closing price after the first day of trading exceeds the offer price. In other words, the stock is originally listed below its market value. The level of underpricing is measured as a percentage of the offer price. Consequently,

to find the level of underpricing of a certain IPO, the closing price is divided by the offer price and subtracted by one.

Early IPO researcher Logue (1973) found evidence for underpricing after the first day of trading. He argued that underpricing is used as a premium paid to investors as a consequence of insufficient information production, which leaves the investors with uncertainty (Draho, 2001).

Bjorn Espen Eckbo (2011) indicated that the average level of underpricing in the US has been 19% since 1960. This supposes that firms continually leave money on the table during an issue. Tim Loughran and Jay Ritter (2002) did research about IPO underpricing over time and found interesting results. *"In the 1980s, the average first-day return on initial public offerings (IPOs) was 7%. The average first-day return doubled to almost 15% during 1990-1998, before jumping to 65% during the internet bubble years of 1999-2000 and then reverting to 12% during 2001-2003."*(Loughran & Ritter, 2002, p. 5). These findings indicate that IPOs are underpriced constantly, but with changing magnitudes. Therefore, a lot of research has been done to find explanations for these observed differences.

Jenkinson and Ljungqvist (2001) differentiated the level of underpricing between industrialized countries and emerging markets. The former averages more than 15 percent underpricing while the latter averages up to 60 percent. The Chinese IPO market is an example of, such an emerging market. Mok and Hui (1998) reported 289% underpricing for a sample of 87 Shanghai IPOs listed from 1990 to 1993. A more recent paper by Tian (2003) disclosed an average initial return of 267% for Chinese IPOs from 1991 to 2000. These empirical results diverge a lot from the average level of 60% in emerging markets (Jenkinson & Ljungqvist, 2001).

Ibbotson, Ritter & Sindelar (1994) differentiated the level of underpricing between firm sizes and found a negative relationship between the size of a firm and underpricing. Furthermore, Carter, Dark, & Singh (1998) used the age of a firm as a proxy for risk. Hence, more established firms are less risky and are associated with a lower level of underpricing.

It can be concluded that there is no unambiguous view that explains the differences in underpricing observed in various markets. Although it is difficult to accurately determine the

magnitude of underpricing, there is consensus with regard to the sign of underpricing, as all the empirical literature has found a positive initial return after the first day of trading.

Besides the empirical results, there is also little consensus about the theoretical implications to explain the underpricing anomaly. Literature about IPOs produced several theories that claim to have explanations for the short-term underpricing anomaly. The most prominent models regarding the anomaly of underpricing will be discussed below.

2.2.1 Information asymmetry between investors

The winner's curse of Rock (1986) states that information asymmetry between different groups of investors explains underpricing of IPOs. There is a clear distinction between investors, with respect to information about the future market price of the shares being sold. It is assumed that only informed investors have access to this kind of information. Those only buy shares from which they know that these are underpriced. Uninformed investors don't know the difference between underpriced and overpriced shares when subscribing and invest in all IPOs.

The implication is that informed investors only buy underpriced shares with on average high positive returns. Uninformed investors don't know whether a share will be underpriced and therefore invest in all shares. The outcome of the allocation process for the uninformed is that those get all of the least desirable shares and only a small fraction of the most desirable shares. This will put them in an unfavorable position and is called the allocation bias. According to the winner's curse: "the more you get, the worse off you are". Because the more shares you get, the larger the proportion of overpriced shares with negative returns. Although, uninformed investors have an information disadvantage relative to informed investors, this does not mean they make irrational decisions. Therefore, issuing firms have to use underpricing as a tool to attract uninformed investors to trade.

Beatty and Ritter (1986) extended the model of Rock (1986), by arguing for a relationship between ex-ante uncertainty and the magnitude of underpricing. Ex-ante refers to predictions that are made about the future market value of the stock, prior to the IPO event occurs (investopedia, 2018). Beatty and Ritter (1986) attached crucial importance to the role of the underwriter. The underwriter is an investment bank that serves to consult the issuing company

during the IPO process. Those bankers ensure that the firm satisfies all regulatory requirements, contacts potential investors and recommends an offer price to the firm (Corwin & Schultz, 2005). In exchange for these services, the underwriter receives a fee ranging from 3 to 7% of the capital being raised during the IPO³ (PWC, 2017). Therefore, setting the offer price is an important task for the underwriter, because it has close relationships with both the issuing firm and potential investors. An excessive offer price may leave the firm with unsold shares, while a too low offer price will result in much missed raised capital from the public offering.

Investor's uncertainty is particularly high if the future performance of a company is unknown. Uncertainty means higher risk, especially for uninformed investors. These investors are driven to acquire more information, which is costly. The higher risk and costs of collecting information have to be compensated by higher expected return. As a result, Beatty and Ritter (1986) argued that a lower offer price, which leads to underpricing, is used to compensate for the higher risk. They also discovered a positive relation between uncertainty on market value and underpricing, meaning that more uncertainty cause higher underpricing.

2.2.2 Information asymmetry between issuers and investors

According to the signaling hypothesis, underpricing is caused by information asymmetry between issuers and investors. The issuer has an information advantage relative to the investor about future market value prospects. The model distinguishes two firm types, high quality and low quality firms (Allen & Faulhaber, 1989). The signaling hypothesis assumes that issuing firms attach value to both proceeds from the initial offering and from a secondary equity offering. It is also assumed that investors are rational and do not know about firm quality until the issue is revealed in the market. Therefore, investors will not distinguish between high- and low quality firms and consider them as pooled. Hence, high-quality firms have an incentive to signal their firm value to potential investors before the issue date. This is because a firm that signals its high firm value prospects to the public will have an advantage with respect to firms that do not use this signaling tool, as these firms will be considered to be in the pooled group. The firms with the most favorable prospects use underpricing at initial public offering as a signaling tool. By

³Capital being raised is calculated by multiplying the offer price with the amount of shares that are sold through subscription. Firms with a large amount of capital raised are associated with a lower bound service fee in percentages.

this, the issuing firm informs the investor that it can carry the costs of underpricing, which differentiates them from low quality firms who cannot afford this loss of money. Ibbotson & Jaffe (1975) stated that underpriced IPOs will create a positive image for the firm, which could ultimately lead to better prices at a secondary offering. Underpricing is viewed as a cost to be borne by high quality firms to secure a higher price at a possible future equity offering (Saunders, 1990). Whereas, low quality firms have the incentive to price its IPO as high as possible, since once the investor collects information about the quality of the firm, its stock price will fall in a secondary offering. Concluding, underpricing could be used as a tool for high quality firms, to distinguish themselves from low quality firms. Moreover, the better the firm the more it will be underpriced relative to a bad issue.

2.3 Platform vs pipeline businesses

This section describes characteristics of the two firm types that are compared in the analysis, i.e. platforms and pipelines.

2.3.1 Description Platform business

A Platform business creates a marketplace for a specific industry and is the intermediary between producers and consumers in high-value exchanges (Parker, Choudary, & Alstynne, 2016). It starts from a demand-side economy point of view. The main characteristic of a platform is that it doesn't sell goods themselves, but facilitates services to connect producers and consumers through the platform and make an exchange of value. Therefore, their chief assets are information and interactions, which together are also the source of value they create and their competitive advantage (Parker et al. 2016). Information attracts people to use the platform, while interaction between producers and consumers provide a great share of the revenue due to service fees. Another characteristic is that a platform is multi-sided. This means that there are two or more kinds of participants on the platform. Airbnb for example, connects house rental owners with house renters.

Development of technology in the last decade, allowed physical marketplaces to become digital ones (Woelderren, 2017). By this, a data layer has been added to the business model, which positively impacts the value creation and makes scaling up easier. Platforms gained the

ability to absorb information from collected data, which is of great importance to stimulate users to create new content and optimize their user experience.

A clear indicator to identify a platform is to look at the current stock of a company. Platform companies do not sell products themselves and consequently have no inventory (Evans & Gawer, 2016). However, it provides a network where others trade with each other. Network effects, also known as demand-side economies of scale, are the main value creator for platforms. These network effects are enhanced by technologies that create efficiencies in social networking, that help networks expand (Parker et al. 2016). The data that a digital platform collects can be used to match different users from various sides of the platform. Platforms that attract a higher volume of users have a higher chance to make a match. Therefore, they offer more value per transaction on average. That is because the larger the network, the better the interaction between demand and supply and the more efficient the data that can be used to find matches.

Revenues are measured based on the average revenue per user (ARPU). The ARPU is an expression of the average revenue that a user generates for the company. It enables investors to compare firms with different sizes, because of the average.

The power of suppliers and demanders and other external forces could add value to the platform business and can be seen as an asset (Parker et al. 2016). Whereas, these external forces from Porter's five forces model are a thread in supply-side economies.

2.3.2 Description Pipeline business

Pipelines create value by optimizing a linear series of activities, known as the value-chain model. Materials from suppliers at the one end of the chain follow a series of steps that transform them into a finished product, where value is added at each step in the value chain (Parker et al. 2016). Pipelines assume supply-side economies of scale. A combination of high fixed costs and low marginal costs creates lower average cost per product relative to competitors, which will result in higher sales volume. This process continues until the entire value chain is optimized. Firms reach competitive advantage by controlling resources, increase efficiency in the supply chain and defend themselves against challenges from porter's five

forces⁴. For instance, one force from Porter's model is bargaining power of suppliers (Porter, 1979). If a supplier has a strong bargaining position, the firm has higher cost to acquire materials from this supplier, which means less profit margin at the end of the value chain. The ultimate goal for a pipeline is to limit the five forces as much as possible to end up with an optimal profit margin.

2.4 Hypotheses

As discussed before, Beatty and Ritter (1986) discovered a positive relation between uncertainty about future market value and underpricing. Meaning that more uncertainty is associated with higher underpricing. Moreover, a share price positively depends on investors' expectations about the firm's performance in the future. When there are good expectations, the share price will increase. As Rock's theory (1986) about information asymmetry between investors describes, investors with a lack of information have to be compensated to attract them to invest in the stock. Consequently, issuing firms compensate with a lower offer price, i.e. increasing the likelihood of underpricing.

Platforms do not sell products themselves and have more content-related assets that create value, based on technology. It's hard to estimate the exact value that is invested in the technology of the platform (Evans & Gawer, 2016). Therefore, investors are left with more uncertainty as it's hard for investors to estimate financial tools like debt to equity ratio, return on capital employed or return on assets for a platform type of businesses. Moreover, investors want to minimize the risk in their portfolio. Therefore, they give high value to factors like credibility and stable growth. On the other hand, the linear value chain business model of a pipeline is easier to define than the value creation model of platforms, based on network effects. From these implications, it could be argued that pipeline's future market value involves less uncertainty with respect to platforms. These inferences lead to the following hypothesis:

Hypothesis 1: The average level of underpricing is higher for platforms relative to pipelines.

⁴ information that elaborates on each of porter's five forces: <https://www.investopedia.com/terms/p/porter.asp>

Uncertainty about the future market value prospects is the main cause for the high level of interest in IPOs, especially during the first trading day. Therefore, I believe there is a positive association between uncertainty and trading volume at the first day of trading. A high level of uncertainty attracts more publicity in financial journals and encourages speculation amongst investors (Liu, Sherman, & Zhang, 2007). Moreover, the liquidity level is expected to be high if an IPO involves a lot of uncertainty, because investors don't know whether they should hold on to the stock or sell immediately after a small increase in return.

The business model of pipelines is less complex than that of platforms and provide owners with more control (Woelderen, 2017). Moreover, the main characteristics of platforms are network effects, no need for ownership of inventory and high customer engagement (Parker et al. 2016). These accompany with more uncertainty relative to the characteristics of pipelines, which mostly contain linear value chain components. These inferences lead to the following hypothesis:

Hypothesis 2: The average first day trading volume of platforms is higher relative to pipelines.

3. Data & methodology

This chapter provides an overview of the data and methods that are used in the analysis. At first, a brief description of the data sources and collection. Thereafter, the variables from the dataset are interpreted and descriptive statistics are presented to get more familiar with the properties of the variables. The chapter ends with the methodology section, which describes the methods that have been used to clearly analyze the difference in underpricing by firm type.

3.1 Data sources

The data is collected from different datasets provided by Jay Ritter on his website⁵. “A list of Rollup IPOs from 1980-2017” shows which IPOs occurred during the period 1980-2017. It also provides the offer date for each firm. I selected the most compatible firms per firm type, after scanning a firm’s characteristics from the dataset on the internet. Firms that are not compatible with the characteristics of both firm types, as described in section 2.3, are excluded. Another part of the data is from “A list of internet IPOs (1990-2013)”. This dataset provides both the offer dates and offer prices for internet companies from 1990 to 2013. Besides the offer date more variables are needed to measure underpricing. The “offer price”, closing price after the first day of trading “Close Price” and “trading volume” are also required. Those were primarily retrieved from NASDAQ. The daily historical stock prices were provided up to ten years back in time. The data of the firms, which have had their public offering more than ten years ago has been retrieved from Yahoo Finance. Besides, firms with missing data on one or more of the required variables are excluded from the dataset.

3.2 Data collection

The number of IPOs varies in different studies, because of different definitions on what qualifies as an IPO (Gjergi, 2005). In this paper, most of the criteria from other empirical studies are used. All firms in the dataset issued their shares on the NYSE⁶. The IPO dates range from 2002 till 2018. IPOs before 2002 are intentionally excluded because the period of 1998-2001 had extremely high average first-day returns compared with the period afterwards. This would

⁵ Jay Ritter’s website: https://site.warrington.ufl.edu/ritter/ipo-data/?doing_wp_cron=1528376623.6924660205841064453125

⁶ NYSE: the New York Stock Exchange is by far the world's largest stock exchange by market capitalization of its listed companies

cause biases, if the amount of companies from that particular period were disproportionately distributed between the firm types. Penny stocks, firms with an offer price below \$5.00, are excluded, because its share price is for a large part based on speculation. Moreover, closed-end funds are also excluded. These are firms whose number of shares is fixed during the lifetime of the fund (Investopedia, n.d.). This could bias the level of underpricing, because the share price of such a fund may deviate from its net asset value. However ADRs are frequently excluded in other studies, those are included in the dataset for this paper. ADR stands for American Depositary Receipt and are stocks that trade in the U.S. but represent a specified number of shares in a foreign corporation (Surbhi, 2016). Alibaba is an example of such a firm. The company is headquartered in China, but its stocks are bought and sold on U.S. markets. Moreover, ADRs trade is U.S. dollars and clear through U.S. settlement systems. This allows investors to avoid transacting in a foreign currency (Investopedia, n.d.). The main reason for excluding ADR's in other studies is because of problems with the quality of the data from the SDC database⁷ (Cici, 2005). As the data for this paper is collected manually, there is no particular reason to exclude ADR's.

3.3 variables

The variable "Firm type" is a nominal variable that includes two categories of firm, platforms and pipelines. A nominal variable cannot be quantified, so it is not possible to perform arithmetic operations with them (Idre, 2016). Moreover, such a variable cannot be ordered by a rank. Therefore, the variable "Firm type" is only used to separate platforms from pipelines.

Underpricing is measured by the variable "Initial Return". The initial return is calculated with the following formula:

$$Initial\ Return\ \% = \frac{(Offer\ price - Close\ price)}{Close\ price} * 100\% \quad (1)$$

Initial Return is numerical and measured in percentages. This allows for comparison with other observations. The initial return is calculated by taking the percentage of the difference

⁷SDC database: stands for security data company and provides all kind of information on securities

between the variables “close price” and “offer price”. Therefore, these two numerical variables are also required.

At first, the offer price. This is the price at which issuing firms sell its shares to investors. The offer price differs from the opening price, as this is the price at which the new shares start to trade in the open market. (Wyatt Inv. research, 2010).

Second, the adjusted closing price is the price at which the newly issued shares close after the first day of trading⁸. The last variable is called “Trading Volume”. This is the amount of shares that are bought and sold during the first day of trading. The trading volume differs from the numbers of shares sold, as a single share usually circulates more than one time during the first trading day.

3.4 Descriptive statistics

Table 1 below shows descriptive statistics separated by firm type. “Obs.” means the number of observations of that particular variable. The mean is the average level per variable. The overall mean of initial return is 18.5%, which includes both platforms and pipelines. The minimum and maximum provide insight in the variability of the range. For example, it shows a large spread in offer prices. The lowest offer price is 5 and the largest 132. The standard deviation indicates how much the individual observations differ from the mean value of the group sample (Niles, 2018). The standard deviation of both firm types exceed its means, which means that a lot of firms in the dataset deviate extremely from the mean.

It is interesting to compare the initial return between firm types. On average, platforms almost double the initial return with respect to pipelines. Moreover, platforms also have the most extreme returns both positive and negative. The highest level of platform’s underpricing largely exceeds that of pipelines, respectively 354% to 186%. The Trading volume follows the same pattern. The maximum level of 421 million is extremely high relative to the pipeline’s 84.4 million.

⁸ The adjusted close price corrects for any corporate actions that occurred at any time before the next day’s open (Investopedia, n.d.). The close price and adjusted close price do not differ at an IPO, because it’s about the first trading day.

Table 1: descriptive statistics either separated by firm type or both firms types combined

Variables	Obs.	Mean	Standard Deviation	Min.	Max.
<i>Firm Type: Combined</i>					
Initial Return (%)	302	18,50%	0.351	-44,25%	353,85%
Offer price (dollar)	302	16,02	10,27	5	132
Close price (dollar)	302	19,31	14,81	4,35	149,01
Sales Volume	302	12.700.000	32.600.000	18.900	421.000.000
<i>Firm Type: Pipeline</i>					
Initial Return (%)	151	12,89%	0.31	-36,90%	185,6%
Offer Price (Dollar)	151	15,00	5,92	5,00	52,00
Close Price (Dollar)	151	17,04	8,45	4,35	53,51
Sales Volume	151	8.368.936	11.000.000	18.900	84.400.000
<i>Firm Type: Platform</i>					
Initial Return (%)	151	24,10%	0,38	-44,25%	353,85%
Offer Price (Dollar)	151	17,04	13,21	5	132
Close Price (Dollar)	151	21,58	18,92	5.14	149.01
Sales Volume	151	17.100.000	44.400.000	97.500	421.000.000

It is interesting to compare the initial return between firm types. On average, platforms almost double the initial return with respect to pipelines. Moreover, platforms also have the most extreme returns both positive and negative. The highest level of platform's underpricing largely exceeds that of pipelines, respectively 354% to 186%. The Trading volume follows the same pattern. The maximum level of 421 million is extremely high relative to the pipeline's 84.4 million.

Another interesting descriptive is the correlation. This is a statistical tool to measure the extent to which variables fluctuate together (Surveyssystem, 2018). A positive correlation means that the variables move in the same direction, so they either both increase or decrease. A negative correlation indicates the extent to which one variable decreases as the other increases. It is important to note that correlations only describe fluctuations of variables, it does not imply causation.

Table 2 below provides correlations of all numerical variables. It shows that Initial return and Close price have a moderate positive correlation. This means that a higher Close price tends to fluctuate with a higher level of underpricing. Moreover, the Initial Return is weakly positive correlated with both the offer price and sales volume. A surprising fact is the weak uphill correlation between Initial return and Sales Volume, which indicates almost no correlation between the variables. This might be explained by the extreme observations of both initial return and sales volume in the dataset, because the correlation coefficient is very sensitive to extreme data values. Therefore, the correlation coefficients table is only meant to provide a better understanding of the relationships between variables and not to conclude on hypothesis.

Table 2: correlation coefficients of the Offer Price, Close Price, Trading Volume & Initial Return

	Offer price	Close price	Trading Volume	Initial Return
Offer price	1.00			
Close price	0.87	1.00		
Trading Volume	0.34	0.30	1.00	
Initial Return	0.09	0.53	0.05	1.00

3.5 Methodology

This section will provide an overview of the assumptions that have to be met to end up with an analysis method that presents an unbiased estimate of the variables. A linear regression would measure the influence of independent variables, such as “sales volume” or “close price” on the level of underpricing. However, this would neglect the purpose of comparing sample group means. Therefore, a two-sample T-test is the preferred model. This test is used to analyze whether group means are significantly different from each other, using the means from randomly drawn samples (Moore, McCabe, Alwan, Craig, Duckworth, 2011). The test involves some assumptions that have to be met.

First of all, it assumes a normal distribution of the sample mean. Figure 1 in the appendix shows a histogram of the initial return on the first day of trading. It shows that the Initial Return is not normally distributed, indeed it is right skewed. Luckily, according to the rule of thumb, the T-test can still be used if the sample size is larger than 100 observations (Moore et al., 2011). The sample size of the dataset that is used for this paper is larger than 100 observations. Hence the distribution of the sample mean can be considered to be approximately normal.

Second, the test assumes independence of observations. This means that outcomes within the sample are entirely independent of each other. There are no companies that appear in both sample groups so this assumption stays intact.

Third, the sample mean and standard deviation of a T-test are sensitive to outliers. Datasets that include values far above the majority of the data points will cause the mean to be substantially higher as well as the standard deviation. Figure 2 in the appendix shows boxplots of the Initial Return and Sales Volume. The blue dots outside the box plot are possible outliers. An outlier is any value that lies a huge distance from most values in a sample (Sebert, 1997).

I did some research about money left on the table, to find out if such large deviations of sales volume or initial return have to be treated as outliers. The amount of money left on the table is calculated with:

$$\text{Money left on table} = (\text{Close price} - \text{Offer price}) * \text{number of shares sold} \quad (2)$$

Jay Ritter (2018) has refreshed data annually, about which public offerings have the largest amount of money left on the table. A high amount is either caused by a high initial Return or high sales volume. Ritter provides a list with the largest 249 IPOs. Almost all of these firm's initial return or trading volume would have been outliers if included in the data sample of this report. Moreover, substantially high initial returns or trading volumes are common in the IPO equity market. Therefore, the values with a high distance from the majority of the observations will not be considered as outliers and are not removed from the dataset.

At last, the test requires homogeneity of the variances. It assumes that the variances of the groups are equal in the population. Hence, it is necessary to test for equal variances

between both group samples with the *variance ratio test*⁹. A 5% significance level is assumed to test for significance. The null-hypothesis assumes equal variances i.e. homoscedasticity, whereas the alternative hypothesis assumes unequal variances i.e. heteroscedasticity. The null-hypothesis should be rejected, as the two-sided P-values for respectively initial return and sales volume are 0.0073 and 0.000. The assumption of equal variances is violated. Therefore, the T-test with unequal variances is the preferred model for both hypothesis. STATA also provides the Welch's approximation. However, this test is not representative as it only increases reliability if the two group samples have unequal sample sizes.

⁹ Table five in the appendix provides the output of the variance ratio test for initial return and sales volume

4. Results

This chapter provides an outline of the main results of the empirical analysis about the level of underpricing. It is split up in two parts. Each part contain the results of a hypothesis. At first the meaning of the hypothesis will be repeated shortly. After, the corresponding results are presented with help of tables. At last, it will be determined if the hypothesis should be rejected. A significance level of 5% is assumed for statistical inferences.

4.1 hypothesis 1 results

Hypothesis 1: The average level of underpricing is higher for platforms relative to pipelines.

The main focus of this hypothesis is to compare the level of underpricing by firm type. As indicated in section 3.3, “Initial Return” is the variable of interest, because it measures the level of underpricing.

Table 3. Two-sample t test with unequal variances that compares the initial return by firm type

Group	Observations	Mean	Std. Error	Std. Dev.
Pipeline	151	0.129	0.025	0.307
Platform	151	0.241	0.031	0.382
Combined	302	0.185	0.020	0.351
Difference		-0.112		
Difference = mean (Pipeline –Platform)				t-statistic -2.805
H0: difference = 0			Degrees of freedom = 287	
Ha: difference < 0				P (T < t) = 0.003

Table 3 provides the output of the two-sample T-test with unequal variances at which the mean Initial return is compared by firm type. This test is used to analyze for a statistically significant difference between the sample means of platforms and pipelines. Moreover, it provides insightful information about the magnitude of the differences and presents the 95% confidence intervals. At last, the t-statistic and degrees of freedom are presented. This enables the user to test for significance manually. From the hypothesis, it is expected that platforms

have a higher level of underpricing, on average, than pipelines. The null-hypothesis assumes equal underpricing sample means between the firm types. However, the alternative hypothesis assumes the difference in initial return to be smaller than zero. This is because platforms are expected to have higher initial returns than pipelines and the difference is calculated by sample mean of pipeline minus sample mean of platform. Therefore, the alternative hypothesis of interest is “difference smaller than zero”. Regularly, the degrees of freedom of a two sample T-test are equal to the total number of observations subtracted by the number of groups. This implies that the test should have 300 degrees of freedom. However, the degrees of freedom of the implemented test deviate, as there are only 286.54. This is because the executed test assumed unequal variances, whereas the general test assumes equal variances. Unequal variances cause the test statistic to be less strong, that’s why it is important to have a dataset with many observations.

The alternative hypothesis “diff smaller than zero” reports a one-sided P-value of 0.0027. This value is significant at 5%. Therefore, it rejects the null-hypothesis of equal initial return sample means between firm types.

4.2 hypothesis 2 results

Hypothesis 2: The average first day trading volume of platforms is higher relative to pipelines.

The main focus of this hypothesis was to compare the level of trading volume by firm type. This is the number of shares that are bought and sold during the first day of trading.

Table 4 provides the output of the two-sample T-test with unequal variances, where the sample mean of sales volume is the variable of interest. The test compares the trading volume sample mean by firm type. Besides, just like at the first hypothesis, the 95% confidence interval is provided as well as different alternative hypothesis. From the hypothesis, it is expected that platforms have more trading volume than Pipelines. The null-hypothesis assumes that the firm types do not have significant differences in sales volume. However, the alternative hypothesis assumes the difference to be smaller than zero. This is because platforms are expected to have higher sales volume than pipelines and the difference is calculated by sample mean of pipeline

minus sample mean of platform. Therefore, just like in the first hypothesis, the alternative hypothesis with “diff smaller than zero” is the one of interest in hypothesis testing.

Table 4. Two-sample t test with unequal variances that compares the trading volume by firm type

Group	Observations	Mean	Std. Error	Std. Dev.
Pipeline	151	8,369	0,895	11,000
Platform	151	17,100	3,614	44,400
Combined	302	12,700	1,875	32,600
Difference		-8,703		
Difference = mean (Pipeline –Platform)				t-statistic -2.337
H0: difference = 0			Degrees of freedom = 168	
Ha: difference < 0			P (T < t) = 0.010	

Besides the P-values, the output of the test also provides T-statistics and the degrees of freedom. The test has 168.3 degrees of freedom, which also deviate from the rule of thumb, because of unequal variances. However, the degrees of freedom are a lot smaller relative to those of initial return. This is because the variances of sales volume by firm type vary more than of initial return, as the sample size of both variables is equal.

The one-sided P-value is 0.0103, which would reject the null-hypothesis of equal trading volumes at significance level of 5%. Therefore, it rejects the null-hypothesis of equal trading volume sample means between firm types.

5. Interpretation & Discussion

This paper investigates to what extent there is a difference in the level of underpricing, between platforms and pipelines, to be observed at an IPO. An empirical data-analysis is executed, which has resulted in interesting outcomes. The main results are followed by a discussion of possible explanations for the findings divided per hypothesis. The discussion is based on findings from previous studies, financial theories and own interpretation. The existing literature differentiates its theories between rational and irrational investors. This paper intends to interpret from a rational point of view and therefore assumes investors to be rational at all times.

To test the level of underpricing, the two-sided T-test has found a significant difference in the level of underpricing per firm type, which stated that the average level of underpricing is higher for platforms than for pipelines. Next, there will be explanations for the higher level of underpricing observed by platforms from multiple points of view.

5.1 Factors that influence investor's perspective on future market value

5.1.1 Ex-ante uncertainty

The underpricing anomaly would not exist in a market without information asymmetry and ex-ante uncertainty. There would not be a distinction between informed and uninformed investors as explained by the winner's curse theory (Rock, 1986) in such a perfect market. All investors would know the exact market value of the issuing firm, which does not leave room for abnormal returns. However, these imaginations of a perfect market do not exist in the stock market. Therefore, ex-ante uncertainty has a large influence on the existence of underpricing at an IPO. According to Beatty & Ritter (1986) the level of underpricing will increase, as uncertainty about the future market value of an IPO increases. More uncertainty induces issues to be riskier and investors demand to be compensated for the amount of risk they take. Therefore, Rock (1986) argued that underpricing is used as a tool to attract investors by increasing their payoff. Koh & Walter (1989) tested Rock's model by using data from Singapore and supported the validity of the model.

The theory of Beatty and Ritter has provided a good foundation to explain the higher level of underpricing for platforms with respect to pipelines. Platforms are assumed to have more ex-ante uncertainty than pipelines for the following reason. It is easier to apply the method of multiples for firm valuation on pipeline firms relative to platforms, which will reduce the relative uncertainty level of pipelines. These multiples are indicators that enable investors to compare the company with firms that have the same approximate value for that particular multiple (Investopedia, n.d.). The most common used multiples are mainly based on revenues. The reason that it is easier to find pipeline multiples is that they have a clearer business model. Value gets added at every step of the supply chain until the product is ready for sale. Revenues largely depend on the price per unit and the amount of sales in units. However, platform's revenue is harder to define. Its revenue is measured by the average revenue per user (ARPU). Its main sources of revenue are advertising and services fees. Platforms with more network effects earn higher revenue per user, as the higher the likelihood of a match between different sides of the platform, the higher the added value per connection. However, these revenue streams are more unclear than that of the well-defined pipeline firms. Therefore, the ex-ante uncertainty about future market value is higher for platforms relative to pipelines.

5.1.2 Growth potential

Not only has the amount of ex-ante uncertainty caused the level of underpricing to fluctuate. Investor's expectations are also affected by factors that influence the prospects of a firm's future market value. The most common method to estimate a firm's value is the Discounted Cash Flow method (Levin & Olsson, 2015). The formula to calculate firm value is:

$$\frac{\text{Free Cash Flow } (t)}{\text{Discount rate}^t} \quad (3)$$

A firm's growth potential forms a large component of the Free Cash Flow. For pipelines, growth potential is the future ability to yield larger profits and expand its workforce to gain more production (Investopedia, 2018). Therefore, pipelines will grow linearly with the amount of value they create by investing in new projects. Moreover, their growth is also affected by changes in market share-and size. On the other hand, the platform business model is based on

technology. Its core value are network effects, which are additive. This means that the more people use the platform, the more value gets added. This causes even more people to use the platform, which creates even more value. Therefore, a platform's growth potential would be exponential to the amount of visitors, instead of linear for pipelines.

Moreover, it is easier for platforms to apply new technological innovations in their business model (Evans, Hagiu, & Schmalensee, 2006). This is because its main asset, the technology of the underlying platform, is designed to adjust quickly to new innovations. On the other hand, it's more difficult for pipelines to adjust, as those normally have a large amount of fixed assets, like machinery. Therefore, it is much harder for pipelines to adapt, as quickly as platforms, to a different business model. Consequently, platforms can adapt much easier, which implies better growth opportunities and firm value prospects.

Growth potential is treated as an important factor of investor's expectations. Better expectations imply more demand and could result in a higher closing price after first trading day, which means more underpricing. Therefore, a higher level of uncertainty and more growth potential are both reasons for platforms to have more underpricing than pipelines.

5.1.3 Investor's perception

At last, investor's perception could also be an influence of underpricing. Platforms could be associated with new technological innovations like the Internet of Thing, Blockchain and Artificial Intelligence. These innovations will open up countless new growth opportunities. So if platforms are associated with these phenomena, investor's perception about the firm value of platforms will be upward biased relative to pipelines. This could lead to higher demand for shares at IPO, more trading volume, higher closing price after the first trading day and ultimately more underpricing.

5.2 Role of the underwriter

Another angle to explain underpricing is through the role of the underwriter in the IPO process. A firm that decides to go public could hire one or more investment banks to take care of the IPO, these banks are called underwriters. The risk and reward are divided by weights, if more investment banks are hired. According to Chemmanur & Khrishnan (2012), underwriters play an important role in the final outcome of IPO pricing for multiple reasons. At first, they contact large prospective buyers of the stock, such as institutional funds and insurance companies with a large investment portfolio. By doing this they also collect intelligence about the available information among investors. The information is usually about investor's beliefs of the valuation of the IPO. Second, the underwriter recommends an IPO price to the issuing firm, after ascertaining the market's demand to the stock. To compensate for these services, the investment bank gets a fee ranging from 3 to 7% of the capital being raised during the IPO (PWC, 2017). Moreover, the underwriter usually agrees to provide a guarantee to the issuing firm to sell a specific amount of stock during the IPO process. If the amount of sales are below this quote, the underwriter has to purchase the surplus themselves (Ozyasar, n.d.). Buying unsold shares is disadvantageous for the investment bank, as unsold stock normally means that the shares are overvalued (Investopedia, n.d.). Therefore, they have to work hard to find potential buyers, to avoid this from happening. However, another tool to avoid buying unsold shares, is to attract more investors by offering the IPO at a lower price. A lower offer price induces a larger difference with the closing price which results in underpricing of the IPO. In general, both the underwriter and issuers benefit from optimization of raised capital. The underwriter maximizes its fee and the issuing firm its capital. However, investment banks also have close relationships with institutional funds and other large investors. Therefore, it is in their best interest to please all parties involved, which results in a conflict of interest between the issuers and the underwriter. A lower offer price satisfies the investors and reduces the probability of obligation to buy unsold shares, but hurts the issuing firm. The issuers are rational and know about this conflict of interest. However, it usually costs too much effort and money to control the actions of the investment banks. Consequently, the underwriter can

underprice the offer to optimize its own interests. So a conflict of interest and a lack of control could result in a lower offer price, i.e. underpricing, to the benefits of the underwriter.

Other studies emphasize a link between investor's demand and underpricing. Spindt & Benveniste (1989) derived a direct relationship between the level of interest in the premarket and underpricing. If investors show high interest in the premarket, the offer price tends to be higher, which results in lower initial return (Spindt & Benveniste, 1989). I believe that the amount of available information causes a difference in premarket interest of investors by firm type. Investors know what to expect from a 'normal' pipeline IPO. The amount of firms to compare with are numerous and the characteristics of the pipeline firm are clearly described. However, platforms are relatively new to the investors. Its financial information is not as clearly defined as that of pipelines. Besides, it is harder to find comparable platform IPOs to use for matching future market prospects. This lack of information could be a reason for investors to have less demand in platform IPOs relative to the IPOs of pipelines. If the underwriter finds out about this fact, it will have to differentiate its advice of the offer price by firm type. Meaning that a pipeline IPO, on average, should have higher offer price than platform's, because a higher offer price raises more capital and could be afforded due to the relatively higher demand.

The main interest of the underwriter is to maximize the amount of capital raised. This is because the service fee of the underwriter mainly consists of a percentage of the capital that has been raised from the IPO. Such a service is a guarantee in which the underwriter promises to sell a specific amount of shares during the IPO process. If this amount hasn't been reached, the underwriter has to purchase the remaining shares themselves. This is very disadvantageous for the underwriter, as these shares are hard to sell.

Concluding, underpricing, i.e. offering at a lower price, provides multiple solutions for the underwriter to compensate for a lack of demand. Not only to improve the value of capital raised, but also to reduce the risk of obligation to buy remaining shares themselves. As it is assumed that investors have less demand for platform IPOs, underwriters would offer the IPOs of platforms for a lower price, which results in more underpricing relative to pipelines.

5.3 Trading volume

The same test is applied to compare the amount of first-day trading volume between firm types. The alternative hypothesis that platforms have more trading volume than pipelines is significant, which means that shares of platforms are traded more frequently than those of pipelines during the first day of trading.

Ex-ante uncertainty could be a reason for trading volume to differ between firm types. Just as explained in the underpricing section, uncertainty could also have a positive association with trading volume. More uncertainty about a firm's future performance increases the risk for investors. Therefore, they plan to buy or sell the stock more frequently in order to gain short-term stock returns within the first day of trading. This induces the trading volume to increase.

Besides uncertainty there are more explanations for trading volume to differ by firm type. Reese & William (1998) found a positive relation between the level of investor's interest in the IPO and initial return, initial trading volume and long-term trading volume. Besides, Chahine (2005) also investigated the relationship between the level of investor's interest and trading volume prior to and after the IPO event and also found the same positive relation.

Yüksel & Yüksel (2006) did research about the direct relationship between underpricing and short-and long-term trading volume. They provided interesting explanations for this relationship. First, underwriters use underpricing to achieve high initial trading volume, since more trading activity leads to higher trading profits after the IPO. Second, underpricing is used as a tool to reward investors for truthfully revealing their private information.

The ownership dispersion hypothesis is another theory to explain the relation between underpricing and trading volume (Booth & Chua, 1995). This means that underpricing is used to increase the probability of having more small shareholders instead of some large funds. This will increase the stock's liquidity and makes it harder for outside investors to challenge management. Booth & Chua (1995) argue that if the liquidity of the market for the shares is higher, the more investors would be willing to price a stock using a lower discount rate. Thus the closing price positively depends on the level of dispersion of ownership.

In hypothesis two, it is assumed that platforms have more trading volume than pipelines. This assumption is built on the level of uncertainty. Uncertainty reinforces speculation and media attention (Liu, Sherman, & Zhang, 2007). This attracts investors as more speculation and risk implies higher probabilities of abnormal returns. Investors know that riskier stocks tend to fluctuate more in a short time frame of a day. Therefore, they hold on to the stock for a lesser amount of time compared to a less risky stock, which means that the trading volume increases. Concluding, more uncertainty could be a reason for platforms to have higher trading volume than pipelines.

It is interesting to mention that other studies only found a one-sided relationship between underpricing and trading volume. As described, underpricing is used for different purposes, from which a change in the level of trading volume occurs. Volatility could be the reason that no other studies found a relation from the amount of trading volume to underpricing. Stock volatility refers to a strong increase or decrease in stock returns within a given time frame (Seguin & Bessembinder, 1993). It occurs during an imbalance in trade orders for a stock for a specific amount of time. This means that a stock is either purchased or sold in large quantities at the same time. Therefore, a higher trading volume could go hand in hand with more volatility, which explains why there is no direct relation found between trading volume and underpricing.

The hypothesis argues for higher trading volume for platforms relative to pipelines. Empirically, the hypothesis cannot be rejected, as a higher average trading volume for platforms has been found. However, a two-sided relationship between trading volume and underpricing has been incorrectly assumed. This indicates that the hypothesis has just provided information about the comparison of trading volume by firm type instead of presenting more insight in the determinants of underpricing.

5.4 implications of the findings

5.4.1 Suggestions for investors

In order to provide reasonable suggestions for investors, the risk and reward of platforms and pipelines in the short-run will be repeated shortly. Platforms were associated with higher initial returns, meaning that the shares that are bought early on the IPOs first trading day gain high returns. The cost to bear these higher returns were more exposure to ex-ante uncertainty and costs to acquire information on future value prospects. However, the business model of pipelines was clear and provided the investors with more control. Therefore, platforms could be associated with the riskier IPO stock compared with pipelines in exchange for a higher return.

If I had to subscribe for shares of an issuing IPO firms, I would invest in a platform. First, the average initial return almost doubles the initial return of pipelines. The main reason for this large difference is the extra ex-ante uncertainty that investing in a platform bears. Though, as the winner's curse of Rock (1986) stated, a large portion of the investors are uninformed. Hence, the level of uncertainty is always high no matter whether they invest in platforms or pipelines. This reduces the gap of uncertainty about future market value between platforms and pipelines, which give uninformed investors more incentives to subscribe for platforms instead of pipelines.

Second, the stock market is built on speculation. The perception of investors on the future market value is a decisive factor. I believe the main value driver of a platform, i.e. network effects, provide a more positive perception on future market value than the linear value chain of pipelines. As described in 5.1.2, platforms could adapt their business structure quicker, as its technology is designed to adjust quickly to new innovations. More growth potential and positive investor's perception could provide more incentives to subscribe for a platform relative to a pipeline.

Concluding, I would advise uninformed investors to subscribe in platform's IPOs. Investing in IPOs overall is risky. The volatility is substantially higher on the first trading day, which could be explained by the higher trading volume on the first trading day compared with other trading days. Therefore, the significant higher initial returns of platforms would outweigh the higher level of ex-ante uncertainty and its associated risk. Informed investors can predict the future

market value of the issuing firm more accurately and should invest in the firm type with the higher return considered the maximal amount of risk the particular investor wants to bear .

5.4.2 Suggestions for potential IPO firms

Underpricing is required to attract uninformed investors to subscribe for shares. However, every little bit of underpricing means money left on the table for the issuing firm, i.e. the offer price is set too low, i.e. the stock is sold below market value. The ex-ante uncertainty was considered to be positively related with underpricing. Platforms could reduce its level of underpricing by providing more accurate information about its firm characteristics to investors. This could contribute to less uncertainty and hence lower underpricing. The average revenue per user (ARPU) was defined to measure revenues and could be seen as a determinant of future market value. A platform could provide data on components of the ARPU, i.e. number of users in different time frames, on its website. By this, it capacitates investors to determine the ARPU themselves, which could reduce the uncertainty about future market value prospects and lower the level of underpricing.

Another tool to reduce the level of underpricing is to change the contract with the underwriter. The investment bank has two interests. First, it aims to maximize its service fee depending on the raised capital, i.e. offer prices times number of shares sold. Second, it wants to keep good relations with large investors. Therefore, the issuing firm has to take measures to incent the underwriter to advise higher offer prices. One tool is using a bonus system in which the issuing firm pays a higher service fee percentage if the level of underpricing drops. This bonus is necessary, because a higher offer price leaves the underwriter with more unhappy clients on the investor side. Moreover, a higher offer price could drastically reduce the number of shares sold, which could decrease the underwriters revenue as it outweighs the slightly increased service fee percentage. Furthermore, relaxing the underwriter's guarantee to sell a specific amount of stock will reduce its incentive to advise a lower offer price.

6. Conclusion

This paper examines the anomaly of underpricing in the IPO market, specifically at the first trading day. Reinforced by the absence of IPO literature about the evolving platform business type, this paper aims to compare the level of underpricing between platforms and pipelines. This has resulted in the following research question:

To what extent is there a difference in the level of underpricing, between platforms and pipelines, to be observed at an IPO and how to explain this difference?

Although other studies have already investigated the level of underpricing for IPOs, a distinction between firm types still lacks in the IPO literature. Therefore, this paper contributes to differentiate the level of IPO underpricing by firm type.

The level of underpricing per firm type was estimated, by using data of 302 US IPOs, from 2002 until 2018. From a two-sided T-test, the average initial returns for platforms and pipelines were respectively, 24.10% and 12.89%, which implied a significant higher initial return for the platform business type. Thus the hypothesis that assumes higher level of underpricing for platforms is accepted. Second, the trading volume per firm type was measured with the same analytical test. This resulted in a significant higher trading volume for platforms, which accepts the hypothesis that assumes platforms to have, on average, higher trading volume than pipelines.

This paper has presented empirical evidence that platforms have a significantly higher level of underpricing in comparison with pipelines. These findings are substantiated with a clear interpretation of the findings. Ex-ante uncertainty appeared to have a positive association with underpricing. A higher growth potential and better investor's perception are also indicators of higher underpricing. Moreover, underwriters use underpricing as a tool to optimize its own interests. At last, volatility, an imbalance of trade orders, could explain why researchers haven't found a relationship between underpricing and trading volume.

Some limitations were found during the writing process. There are possible biases in the results, as the T-test did not control for variables that could have affected the level of underpricing between firm types. More specifically, the size of market capitalization, period of the IPO and the issue size of a firm could influence the investor's level of uncertainty or

perspective on future market value. Controlling for these variables could have resulted in different outcomes, but would not change the conclusion drastically. Furthermore, the measures used to construct the dataset were not based on a uniform typology that described which firms are either platforms or pipelines. Though, it was based on characteristics that were outlined by journal articles and books. Researchers that gain their knowledge based on other articles could have constructed a different dataset, which would have resulted in different results.

For further research, it would be interesting for issuing firms to find out about the optimal IPO method, i.e. auction or book building, for their firm type. This could be done by measuring the level of underpricing per firm type for both IPO methods. Moreover, it would be interesting to expand the dataset with more observations and more variables, to provide statistically substantiated explanations for the higher level of underpricing of platforms. For example, the initial return of the firms could also be compared by market size, age or the number of risk factors. At last, Carter, Dark, & Singh (1998) used firm age as a proxy for risk. Hence, older firms are less risky and associated with a lower level of underpricing. It would be interesting to test their theory backwards, by using data from this research. Platforms have, on average, more underpricing at its IPO and tend to be riskier than pipelines. Finding out how this relates to firm age could provide new insight in the theory of Carter, Dark, & Singh.

7. References

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Appendix

Figure 1: histogram of the initial return on the first day of trading providing graphical image. The histogram shows that the initial return is right-skewed and the majority of the firms have an initial return of 0 to 25 percent.

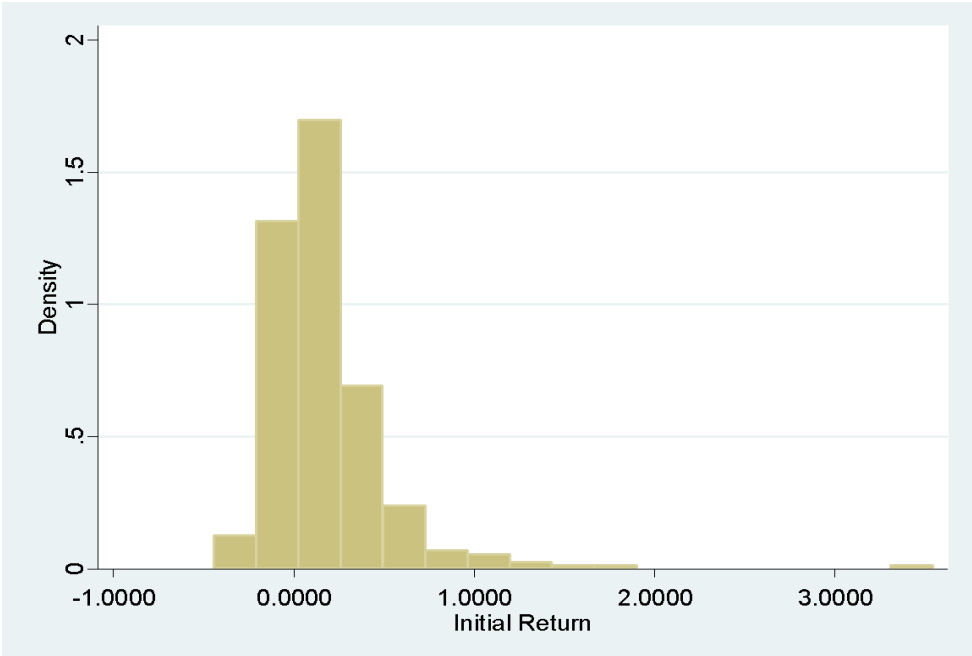


Figure 2: boxplots of the Initial Return and Sales Volume on the first trading day.

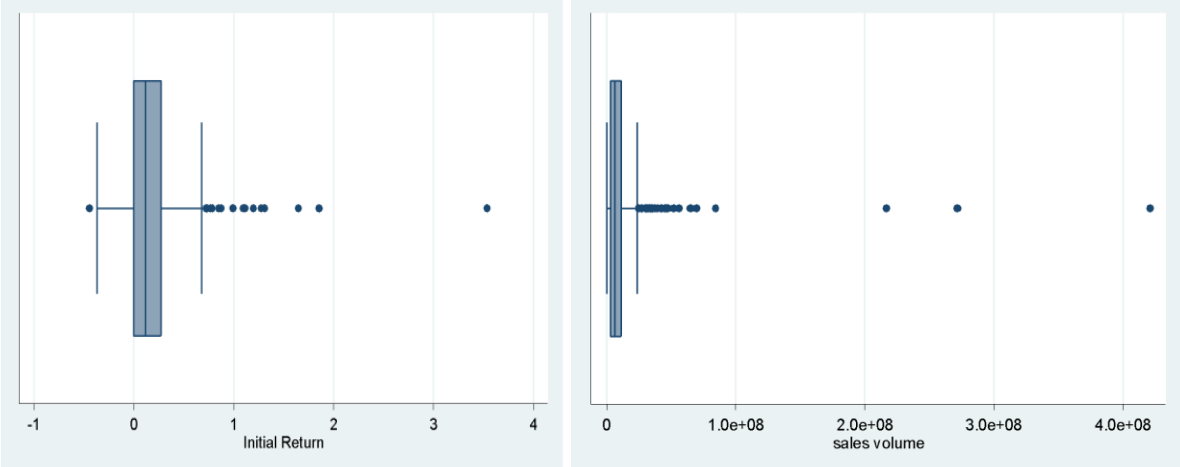


Table 5: variance ratio test to test for equal variances of initial return among groups. The ‘Ha: ratio! = 1 is significant and means that the variances are not equal. Therefore, the variances of initial return are not equal.

Variance ratio test

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Pipeline	151	.1289286	.025003	.3072425	.079525	.1783323
Platform	151	.2409871	.0311628	.3829344	.1794125	.3025618
combined	302	.1849579	.0202032	.3510949	.1452004	.2247154

```

ratio = sd(Pipeline) / sd(Platform)          f = 0.6437
Ho: ratio = 1                                degrees of freedom = 150, 150

Ha: ratio < 1          Ha: ratio != 1          Ha: ratio > 1
Pr(F < f) = 0.0037    2*Pr(F < f) = 0.0073    Pr(F > f) = 0.9963

```