IPO UNDERPRICING IN THE TECH SECTOR: IMPACT OF THE PROSPECTUS SUMMARY VARIABLES

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Abstract

Aiming to provide guidance to researchers regarding publicly available factors associated with tech IPO underpricing, this thesis investigates the impact of the information contained on the prospectus summary on underpricing. In a sample of 131 tech IPOs listed in the U.S. between 2010-2017, was found evidence that IPOs with larger spreads are associated with more underpricing, IPOs with larger gross proceeds and with dual-class shares underprice less and that book-to-market ratio and underwriter reputation do not have significant impact on underpricing. Great majority of the results challenge hypothesis derived upon previous literature. Inherent characteristics of the tech industry, advances on information technology, continuous regulatory changes, increase in regulatory scrutiny and changes on U.S. IPO market trends were proposed and discussed to be drivers of such outcome.

Key words: IPO; underpricing; prospectus; tech; book-to-market; gross proceeds; underwriter spread; dual-class shares; underwriter reputation

Introduction

This thesis is focused on the impact of the information contained in the final prospectus summary on the underpricing. It investigates tech initial public offerings, also known as unseasoned equity offerings, (hereafter “IPOs”) on the U.S. stock exchange. Moreover, it is designed to avoid turbulence caused by the dot-com bubble and the recent financial meltdown, thus the period 2010 to 2017 is analyzed. The selected explanatory variables are Book-to-Market; Gross proceeds; Underwriter spread; Dual-class shares and Underwriter reputation.

Before any sale of shares to the public may be allowed, companies are required to file the final prospectus with the U.S. Securities and Exchange Commission (hereafter “SEC”). Such document full-disclosures firm-specific information, and it is further scrutinized by potential investors, being their primary source of information prior to the offer. Ritter (2003) documented that IPO underpricing (i.e., first day average returns) is a common factor present in the great majority of the world equity markets. As a result, literature provides numerous non mutually exclusive reasons for the new issues underpricing, yet still fails to fully explain the phenomenon. However, by concentrating the study around the core (publicly available) information of the final prospectus, by choosing the U.S. tech IPOs sector as a sample and by further aggregating fundamental underpricing theories and previous empirical findings, I was able to estimate the relationship between the variables of interest in such a specific form that might induce future researchers to change specifications on IPO underpricing and ultimately contribute to its full explanation. All in all, this thesis primarily aims to provide guidance to researchers regarding publicly available factors associated with tech IPO underpricing, and consequently highlighting new areas for future research.

Even though not extensive, some literature has dedicated special attention to the prospectus. For instance Daily et al. (2005), who found no evidence of a relation between variables present on the prospectus and IPOs final offer price nor IPOs offer price spread. A result that confirmed Loughran and Ritter (2002) suggestions, that IPOs final price adjustments only partially incorporate publicly available

information. Conversely, when the subject of analysis is underpricing, Hanley and Hoberg (2010) argued that greater informative content on the prospectus (i.e., “a proxy for premarket due diligence”) led to more accurate offer prices. They suggested that a passive evaluation of IPOs prospectus, using text analysis, may be useful for potential investors. Such findings are in accordance with Leone et al. (2007), who verified that when the issue company disclosed information regarding the “use of proceeds”, the subsequent IPO underpricing was lower.

Through meta-analytic techniques, Daily et al. (2003) documented the correlation of numerous variables with IPO underpricing. Interestingly enough, the results showed that great majority had statistically significant relationships opposite than the ones hypothesized. As a consequence, Daily et al. (2003) suggested that researchers should be encouraged to consider alternative specifications on relevant questions and study methods, within IPO underpricing.

The latter suggestion is the main motivation for this thesis. Similarly to Daily et al. (2003), I analysed the relation of different variables with underpricing. In a similar manner, I recognized the special importance of aggregating and summarizing diverse results from previous studies, since IPO underpricing research still yields contradictory or inconsistent findings. Furthermore, I share the same prospectus focus as Daily et al. (2005) and Hanley & Hoberg (2010). Nevertheless, the specifics of my data allowed me to incorporate recent literature in my analysis and to report some new results. The new empirical evidence provided in this thesis may be valuable for future research within the topic.

This thesis provided evidence that IPOs with larger underwriter spreads are associated with more underpricing, that IPOs with larger gross proceeds and dual-class shares underprice less and that book-to-market ratio and underwriter reputation do not have significant impact on IPO underpricing. Great majority of the reported results were not in line with hypothesis derived upon previous literature. Characteristics inherent to tech firms and to the time period analysed were discussed and proposed to influence such outcome.

The structure of this thesis is as follows. Section I summarizes relevant literature to motivate the thesis. Section II introduces theory in order to support the testable hypothesis. Section III describes the data and methodology. Section IV outlines the

summary statistics, provides empirical analysis and interprets the findings. Section V concludes the paper with a summary and suggestions for future research.

I. Literature Review

An IPO is the mean to get an equity capital infusion to fund new projects, to improve credit standing or to simply provide liquidity to its founders (Iannotta, 2010). Zingales (1995) argued that by selling to dispersed shareholders, entrepreneurs can maximize their proceeds from the sale of cash flow rights. In fact, whitin private equity firms, IPO is the favorite way to liquidate investments (Zingales, 1995). As evidence, Ritter and Welch (2002) showed that companies going public in the U.S. from 1980-2001 have exceed one per business day. Furthermore, according to Berk and DeMarzo (2014), IPO's characteristics such as cyclicity, high costs, long-run (3-5 years after IPO) poor performance and underpricing, have puzzled financial economists. Hence, during the past three decades a fair amount of research has been dedicated to such thematics. Nevertheless, for the sake of this thesis, only underpricing will be further discussed and analysed.

Ibbotson and Ritter (1995) argued that publicly traded companies are known to have large ongoing costs connected with the mandatory need to disclose information, on a regular basis, to investors and regulators. There are other substantial one-time costs that are incurred when performing an IPO. Firstly, the direct costs, such as legal, auditing, and underwriting fees. Secondly, the indirect costs, namely management time and effort dedicated to conduct the offering, and the "dilution" associated with selling shares at an offering price that is, on average underpriced, (Ibbotson and Ritter, 1995).

Loughran and Ritter (2002) suggested that underpricing represents the largest part of the IPO costs. For instance during 1990-1998 companies going public in the U.S. left more than $27 billion "on the table" (i.e., the difference between the offer price and the first closing market price, multiplied by the number of shares sold was $27 billion). In fact, the $27 billion mark was twice as large as the $13 billion spent on underwriter fees. Even more surprising, these same companies had only

generated profits of roughly $8 billion in the year before IPO. Thus the amount of “money left on the table” represented more than 3 years of aggregate profits. Yet issuers not only seemed to not mind, but appeared to be even satisfied with the offer price. The 15 IPOs that were underpriced by more than 60% and subsequently conducted a seasoned equity offering (hereafter “SEO”), all retained the same lead underwriter from the IPO. Therefore, it might seem contradictory that the main purpose of going public is to obtain liquidity, and apparently issuers not mind about “leaving money on the table”. However, empirical evidence of a covariance between such losses and anticipated changes in the wealth of the issuing firms decision makers, suggested that issuers prioritize changes in their wealth over the level of wealth, (Loughran and Ritter, 2002).

Initial evidences of underpricing can be tracked as far back as 1963, in a study by SEC (Ibbotson and Ritter, 1995). Ever since literature has explored possible reasons for IPO underpricing. First, investors may need compensation when facing market incompleteness, specially within new industries (Mauer and Senbet, 1992). Second, excess demand caused by underpricing leads to a large number of relative small shareholders, who consequently have low vote power on challenging the firm's decision makers (Brennan and Franks, 1995). Third, allocating shares in underpriced IPOs is considerable valuable, hence underwriters can use such as means of retaining or obtaining new businesses, a practice known as “spinning”. Fourth, underpriced IPOs can serve the purpose of “signalling” high value, allowing the firm and insiders to sell future SEOs at a higher price that otherwise would not be acceptable by the market (Welch, 1989). Sixth, the “cascades hypothesis” refers to the importance of underpricing in attracting the first few investors, further inducing a consequent flow of interest from other investors, that prioritize the fear of missing out over their private information (Welch, 1992). Seventh, in a market where offered shares are fixed and information is asymmetric between investors, the uninformed investors will end up with the least desirable issues, i.e., overpriced IPOs, a practise known as the “winner’s curse”. Consequently, uninformed investors will be only encouraged to submit purchase orders if, on average, IPOs are underpriced (Rock, 1986). Eight, underpricing helps to reduce the frequency and severity of future lawsuits due to material omissions in the prospectus (Tinic, 1988). All mentioned

hypothesis and suggestions were well summarized by Ibbotson and Ritter (1995). In Section II, further elaboration on the “winner's curse theory” and “signaling theory” is done in order to support the testable hypothesis of this thesis.

The level of underpricing has not been constant over time. Loughran and Ritter (2004) documented that changes on issuer preferences, emergence of a lead underwriters oligopoly, increase on regulatory scrutiny and a shift towards IPOs of firms with negative earnings and technology stocks, have been the main drivers of such fluctuations. Similarly, Johnston & Madura (2000) found evidence that IPOs underpricing is affected by industry specific variables, namely ownership structure, regulations and operating characteristics. In addition they verified that internet focus companies registered higher underpricing than a comparable set of IPOs, supporting the importance of the shift towards tech IPOs on underpricing trends. Two operating characteristics of technological firms should be highlighted. First, tech companies typically have few tangible assets, rather having significant intangible assets in the form of patents and other intellectual property (Kim and Pukthuanthong-Le, 2008). Second, technological innovations have a long development period, during which few signals (e.g., cash flows) on its outcomes are provided (Francis et al., 2012).

Furthermore, cross-country analysis, such as Hopp and Dreher (2013) showed that countries with stricter law enforcement, larger availability and transparency of accounting information, have lower underpricing. Likewise, Boulton et al. (2017) demonstrated that countries where firms practise more accounting conservatism the underpricing is smaller, due to a positive influence on mitigating the information asymmetry.

II. Theory & Hypotheses

Apart from serving the purpose of attracting uninformed investors into the market, Rock’s (1986) theory also suggested that underpricing serves as a remuneration to investors for the costly investigations of becoming informed. Thus, riskier firms should register higher underpricing than firms easier to evaluate, due to the latter require less compensation for informed investors. Using *ex-ante*

uncertainty as a proxy for risk, Ritter (1984) has developed a hypothesis of Rock's "winner's curse theory". In general, the greater the uncertainty about the true price of the new issue, the greater the advantage of the informed investors and consequent larger underpricing must be offered to attract uninformed investors into the market. Furthermore, Beatty and Ritter (1986) found evidence of such implication, suggesting that if *ex-ante* uncertainty is endogenous, an issuing firm has an incentive to reduce it by voluntarily disclosing more information.

In the original formulation of "signaling theory", Spence (1973) assumed that potential employers are short on information regarding the quality of job candidates. He further used the labor market to model the signaling function of education, suggesting that candidates obtained education to signal their quality and reduce information asymmetries. The efficiency of a signal depends on its observability and cost, the latter introduces the fact that higher quality signalers are in a better position to absorb the associated cost. Thus, Spence's signaling model showed reliability due to evidence that lower quality candidates' lack on abilities to withstand the rigors of higher education and get a diploma.

In a similar manner and as a result of the information asymmetry problem, IPO firms may seek ways to signal the quality of the investment opportunity to potential investors. Therefore, by assuming that the best information regarding the new firm's prospectus is held by the firm itself and not by the informed investors, as in Rock's assumptions, Welch (1989) inferred that higher quality firms use underpricing to signal quality. The strength of the signal is justified by the cost of diminishing the IPO proceeds. Moreover, Welch (1989) argued that to compensate the associated cost, the firm must benefit sufficiently at the time of a SEO. However, Ibbotson and Ritter (1995) cast doubt on the empirical evidence of signalling as a reason for underpricing, since literature failed to relate underpricing with subsequent SEOs.

Furthemore, other studies drew attention on identifying signals that influence IPO underpricing rather than study underpricing as a signal by itself. For instance, corporate governance (Filatotchev and Bishop, 2002), founder CEO (Certo et al., 2001) or top management team reputation (Cohen and Dean, 2005). Although, a recent replication study by Park et al. (2016), found evidence that signals previously proved to influence IPO underpricing, no longer seemed to apply in the present

context. Park et al. (2016) hypothesized that such findings were due to the advances of information technology and regulatory changes concerning the quiet period prior to the IPO, resulting in the acces of “rich fine-grained” information and on the “democratization of IPO-related information”.

Consistent with “signaling theory”, Park and Patel (2015) documented that IPO underpricing is reduced when the prospectus contains less ambiguous information. This result implies that a more reliable signal of the IPO’s quality is created, and further *ex-ante* uncertainty is decreased, which is in line with Beatty and Ritter (1986) suggestions.

Observing Annex A - “Facebook” final prospectus summary, which is given as an example of the standardized structure of such document, it is possible to verify that the main variables are the following listed below:

Offer Price (Book-to-market per share):

Jain and Kini (1999) results indicated that a small offer price signals little demand and/or small value. Similarly, Seguin and Smoller (1997) argued that lower-priced issues have higher chance of underperforming, in fact they empirically proved that such issues have “higher mortality rate”. In a similar manner and by using the book-to-market equity as a scaled version of a firm’s stock price, Fama and French (1992) found evidence of a positive relation between cross-sectional average returns and book-to-market equity. Further implying that a higher book-to-market ratio of equity (i.e., a low stock price respective to book value) prospects a firm to perform poorly. Therefore, under Ritter’s (1984) suggestion it is possible to infer that smaller offer prices and higher book-to-market ratio have higher IPO *ex-ante* uncertainty and a consequent higher underpricing. Nevertheless, literature showed that book-to-market ratio relative explanatory power on average stock returns decreases when firms have many intangible assets (Park, 2017) and negative equity (Peterkort & Nielsen, 2005). To avoid collinearity, since offer price is part of the computation of both underpricing (dependent variable) and gross proceeds, I used book-to-market per share as a scaled version of the offer price. Hence, I follow hypothesize that:

H1: Book-to-market per share is positively related to underpricing.

Gross proceeds:

When searching for a proxy of *ex-ante* uncertainty for an IPO, Beatty and Ritter (1986) used the inverse of the gross proceeds. As evidence of the empirical regularity found by Ritter (1987) that smaller offerings are more speculative, on average, than larger offerings. Hence, it can be inferred that offers with larger gross proceeds lead to less underpricing. Thus, I hypothesize that:

H2: Gross proceeds are negatively related to underpricing.

Underwriter spread:

The underwriter spread (hereafter "spread") is computed by dividing the underwriter commission & discounts per share (hereafter "fees") by the final offer price per share. Chen and Ritter (2000) verified that in issues with proceeds between $20 to 80 million "(in dollars of 1997 purchasing power)", more than 90% had spreads of exactly 7%. Such spread cluster was more expressive in high valuable deals, due to the fact that smaller offers tend to include additional forms of underwriter compensation, such as "nonaccountable expense allowances", i.e., warrants, allowing more room for variations. Furthermore, Chen and Ritter (2000) argued that the 7% mark is "above competitive level", hence it is in the best interest of investment banks to avoid competition on price, thus maintaining this "strategic pricing". Nevertheless, Hansen's (2001) tests did not support the collusion theory. He argued that the IPO market has low concentration, it's ease of entry, and a "7% spread is not abnormally profitable nor has its use been diminished by public awareness of collusion allegations", referring to the class action lawsuits that took place after Chen and Ritter (2000) suggestions.

Chen and Mohan (2002) results verified that higher underpricing often is accompanied by higher underwriter spread. Additionally, they found that the IPO market is segmented, where certain new issuers do not have access to some underwriters. As a result, for medium-reputation underwriters the spread has a negative impact on underpricing, suggesting a substitution relationship. However, for low- and high-reputation underwriters, spread is positively related to underpricing, indicating a complementary relationship. In a similar manner, Garner and Marshall

(2010) suggested that higher fees might be charged in order to mitigate the reputational costs and underwriting risks associated with firms that underperform in the long-run. Therefore suggesting that overcharge by the underwriter may act as signal to investors about future underperformance. Therefore I hypothesize that:

H3: Spread is positively related with underpricing.

Dual-class shares:

Firms that deviate from the one share one vote regime, go public with dual-class shares. According to Arugaslan et al. (2010), such allow insiders to diversify their portfolios, while retaining majority of the control. Moreover, Smart and Zutter (2003) documented that dual-class firms experience, in average, smaller underpricing than the single-class counterpart. Likewise, Brennan and Frank (1997) argued that faced with threat of ownership dispersion of control rights, dual-class managers have little or no incentive to underprice the issue. A perspective partly shared by Chemmanur and Jiao (2012), who argued that entrepreneurs[1] implementing projects with high short-term uncertainty use dual-class shares to hold enough voting power and further decrease chances of losing control. Even though Arugaslan et al. (2004) achieved similar results, they instead suggested that because dual-class IPOs tend to be larger than single-class IPOs, the latter has to be more underpriced under the typical uncertainty/asymmetric information arguments. As such, I hypothesize that:

H4: IPOs with dual-class shares exhibit lower underpricing.

Underwriter reputation:

Numerous studies, such as Carter et al. (1998), Carter and Manaster (1990) and Johnson & Miller (1988) found empirical evidences that IPOs underwritten by investment banks with higher reputation are less underpriced. Carter (1992) documented that prestigious investment banks are more likely to discount their

[1] Chemmanur and Jiao (2012) defines entrepreneur has the person that "currently owns all the equity in his private firm, and who wishes to sell equity to outsiders in an IPO to raise external financing to implement his firm's project".

underwriter spread. Furthermore, Johnson & Miller (1988) proved, under proxies of *ex-ante* uncertainty, that prestigious underwriters have a tendency to be associated with lower risk offerings. Consequently, Carter and Manaster (1990) suggested that "with less risk there is less incentive to acquire information and fewer informed investors", leading to lower underpricing. As such, I hypothesize that:

H5: Reputation of the lead underwriter is negatively related to underpricing.

Over-allotment option:

Previous studies, such as Chen and Ritter (2000), found that nearly all IPOs exhibit a 15% over-allotment option (also known as greenshoe provision). In fact, Chen and Ritter (2000) documented that time-series and cross-sectional variations are virtually nonexistent. Therefore, even if present in the prospectus summary, over-allotment option will not be part of my analysis.

III. Sample Data and Methodology

In order to avoid the empirical evidences of differences in cross-country, cross-industry and further turbulence registered during the dot-com bubble and the financial meltdown, I initially selected 187 IPOs from the technologic sector, listed between 2010-2017 on the U.S. Stock Exchange (NASDAQ, NYSE and AMEX). Moreover, observations with missing final prospectus data, missing age and/or underwriter reputation measures, and companies offering American Depositary Receipts (issued by non-U.S. firms and that are listed in at least one other market outside the U.S., hereafter "ADR") were excluded from the final sample. Corresponding to 24, 3, and 29, respectively. For the purpose of obtaining a robust estimation, all non-dummy variables were winsorized, as in Tukey (1962). "Outliers are replaced its original value by the nearest value of an observation not seriously suspected (of being an outlier)". Therefore, a total of 33 observations were winsorized due to appear as outliers on the boxplots (5th and 95th percentile) across

the different variables. Annex B shows the boxplots of non-dummy variables after the winsorization. Consequently, the final number of IPOs studied was 131.

The mentioned IPOs were extracted from NASDAQ's database[2], when selecting for "technology sector", which contains companies from the following industries: Companies Computer Software; Programming, Data Processing; Computer Software: Prepackaged Software; Diversified Commercial Services; Computer Communications Equipment; Electronic components; Semiconductors; Industrial Machinery/Components; EDP Services; Telecommunications equipment; Radio And Television Broadcasting And Communications Equipment; Advertising; Professional Services; Computer Manufacturing; Electrical Products; Computer peripheral equipment; Retail: Computer Software & Peripheral Equipment.

To calculate the dependent and explanatory variables, key data was individually gathered from the final prospectus of the companies on the SEC's Electronic Data Gathering and Retrieval (EDGAR) website[3]. I used the code listed as filing "424B", which is an acronym that derives from the rule number that require the firm to file a prospectus, Rule 424(b). Additionally, to compute the underpricing I used Thomson Reuters Eikon, from where I extracted the first trading day closing market price for each individual IPO.

Moreover, to estimate the relationship between the variables present in the prospectus summary and underpricing, the following cross-sectional Ordinary Least Squares (hereafter "OLS") regression was estimated:

$$Underpricing_i = \beta_0 + \beta_1 BOOKtoMarket_i + \beta_2 LnGroosProceeds_i + \beta_3 Spread7_i + \beta_4 DualClass_i + \\ + \beta_5 HighR_i + \beta_6 Age_i + \beta_7 Hot_i + u_i$$

[2] Source: NASDAQ's database available at https://www.nasdaq.com/screening/companies-by-industry.aspx?industry=Technology (accessed March 18, 2018)

[3] Source: Companie's final prospectus summary are availabe at https://www.sec.gov/edgar/searchedgar/companysearch.html (accesed at March 18, 2018).

(i) Dependent variable

$Underpricing_i$: Is computed by $\frac{PC_i - P0_i}{P0_i}$, where the offer price is represented by ($P0_i$), and (PC_i) is the market closing price of the first trading day. According to Beatty and Ritter (1986), the underpricing calculation doesn't require market movement adjustments, since $P0_i$ is generally within a few days of the offering date, hence market movements can be assumed to have little influence.

(ii) Explanatory variables

$BOOKtoMarket_i$: Using the same formulation as Holmén and Wang (2015), the book-to-market ratio was calculated as the net asset value per share (NAP_i) before the IPO, divided by the final offering price per share ($P0_i$).

$LnGrossProcceds_i$: Consistent with the literature, it is computed as the natural logarithm of the total number of shares offered in the IPO ($S0_i$) multiplied by the offer price per share ($P0_i$). Furthermore, it is expressed in terms of U.S. dollars of 2010 purchasing power by using the U.S. GDP implicit price deflator[4] (PPC_{10_i}). The proceeds provenient from over-allotment options are excluded.

$Spread_i$: It is computed by dividing the underwriter fees per share (U_f) by the offer price per share ($P0_i$). Because of Chen and Ritter's (2000) empirical evidence of a market clusterization around the 7% mark, I created the following dummy variable:

- $Spread7_i$: Equals to 1 if $Spread_i$ is equal to or greater than 7%, and 0 otherwise.

$DualClass_i$: It is represented by a dummy variable, which equals to the unity when the firm going public has more than one class of shares, and 0 otherwise.

[4] Source: Federal Reserve Economic Data, available at https://fred.stlouisfed.org (accessed March 22, 2018)

$Ranking_i$: In this case the empirical analysis was facilitated by Loughran and Ritter (2004) development of an observable reputation variable for the underwriters. I used the ranking available in Ritter's database "IPO Underwriter Reputation Rankings (1980 – 2015)"[5], where the underwriter reputation variable ranges from 1.001 up to 9.001, with 0.5 intervals. Due to lack of data availability, I assumed that values have maintained constant after 2015. Furthermore, for IPOs with more than one lead underwriter (also known as bookrunner), the average of their rankings was computed. For further discussion please see Loughran and Ritter (2004). As a result of Chen and Mohan (2002) suggestions on IPO market segmentation, I divided Ranking into high ranked and low ranked underwriters, hence the following dummy:

- $HighR_i$: Equals to 1 if $Ranking_i$ is strictly greater than 8.501, and 0 otherwise.

(iii) Control variables

Age_i: Ritter (1991) documented that underpricing was smaller for older firms, confirming the notions that riskier IPOs require higher underpricing and that age can be used as a proxy for this risk. Similarly, Megginson and Weiss (1991) included in their regressions age as a control for the degree of information asymmetry. In accordance with these two studies and with Carter et al. (1998), firm age was measured as the natural logarithm of one plus the firm's age (i.e., difference between the year of the IPO and the year of foundation).

The year of foundation was extracted from Ritter's database "Founding dates for IPOs from 1975-2017 (updated January 2018)"[6]. Please see Annex B to clarify how Ritter decided the exact year a company was founded.

Hot_i: Following Ibbotson and Jaffe (1975), a "hot issue" market is defined as periods in which the average underpricing is abnormally high. Ibbotson and Ritter (1995) hypothesized that optimistic investors assuming presence of a positive autocorrelation in the underpricing, can explain the existence of "hot issues". Those

[5] Source: Jay R. Ritter database, available at https://site.warrington.ufl.edu/ritter/ipo-data/. (accessed March 18, 2018)
[6] Source: Jay R. Ritter database, available at https://site.warrington.ufl.edu/ritter/ipo-data/. (accessed March 22, 2018)

investors are willing to bid up the price of an IPO, when knowing that other recent IPOs have risen in price. Consequently, if enough investors follow such strategy, a positive autocorrelation of underpricing is induced. Moreover, Ritter (1984) finds evidences that "hot issue" periods are characterized by riskier issues. Rajan and Servaes (1997) suggested that over optimistic analysts use "hot issue" periods as "windows of opportunity" to complete more IPOs. However since such periods are driven by "inflated expectations", it eventually results in average low quality IPOs. In contrast, Grinblatt and Hwang's (1989) "signaling model" implied that "hot issue" markets are characterized by higher expected profitability. In line with Welch (1989), they argued that underpricing is positively related with firm value.

In order to avoid a control variable directly based on the dependent variable (underpricing), I used "money left on the table" as an alternative measure of underpricing to define "hot issue" market, under Nguyen et al. (2010) arguments. Thus, the average annual aggregate "amount left on the table" of all IPOs listed on NASDAQ, NYSE and AMEX during the period 1980-2017 ($4.19 Billion)[7] was used as a threshold to define "hot issue" markets during 2010-2017. Hence, years where the aggregate "amount left on the table" of all IPOs listed in the NASDAQ, NYSE and AMEX was strictly greater than $4.19 Billion, namely the year of 2013 ($7.94 Billion)[8] and 2014 ($5.40 Billion)[9], were considered "hot issue" markets. Likewise, the variable Hot_i equals to the unity when the IPO took place in 2013 or 2014, and 0 otherwise.

IV. Results and discussion

(i) Descriptive statistics

Table 1 provides the annual distribution of the variables across the period studied. A number of observations can be made. First, as most of the literature,

[7] Source: Jay R. Ritter's "IPO Statistics for 2017 and Earlier Years" database, available at https://site.warrington.ufl.edu/ritter/ipo-data/. (accessed May 1, 2018)
[8] Source: Jay R. Ritter's "IPO Statistics for 2017 and Earlier Years" database, available at https://site.warrington.ufl.edu/ritter/ipo-data/. (accessed May 1, 2018)
[9] Source: Jay R. Ritter's "IPO Statistics for 2017 and Earlier Years" database, available at https://site.warrington.ufl.edu/ritter/ipo-data/. (accessed May 1, 2018)

evidences that IPOs are in average underpriced were observed. As matter of fact, tech IPOs registered higher underpricing than the average IPO listed in the U.S. between 2010 to 2017 (26% vs. 15.5%)[10], a result similar to the one obtained by Johnston & Madura (2000) and in line with Boulton's et al. (2017) suggestion on tech companies having higher information asymmetry. In fact, such result was not only valid for the average underpricing between 2010-2017, but as well as for every single year within the period. Second, 29% of tech IPOs had dual-class shares, a higher percentage when compared with non-tech IPOs (15.7%)[11]. Third, tech IPOs were more common from 2014 onwards, where 65% of the observations took place. This can be partly attributed to the total higher number of completed IPOs during that particular period[12]. Fourth, average book-to-market (hereafter "B/M") ratio exhibited a minimum on 2017 (0.26), suggesting that average offer price was much higher than the worth of the IPOs assets. Fifth, the same spread cluster referred by Chen and Ritter (2000) was observed. 74% of the IPOs had a spread of exactly 7%, and when adding issues with a spread strictly greater than 7% the total rises to 79.4%. Sixth, high ranked investment banks represented 57.3% of the bookrunners on tech IPOs. This is an expected result since Loughran and Ritter (2004) argued that there is a bookrunner oligopoly. Lastly, the 2010-2017 aggregate gross proceeds, expressed in 2010 U.S. dollars, was $42,282.4 millions. Nevertheless it is important to mention that within the sample was the 2012 Facebook, Inc. "FB" IPO, which according to FINRA[13] is currently the fourth biggest IPO in the U.S. history. FB alone was responsible for 36.4% of the total aggregate gross proceeds between 2010 to 2017, registering $15,399,425,336 gross proceeds (2010 U.S. dollars).

Table 2 lists some descriptive statistics of non-dummy variables. *Underpricing* showed a standard deviation of 0.27. Moreover, the most underpriced tech IPO was 87%, whereas the tech issue most overpriced was 19%. The smallest *BOOKtoMarket* was -1.14, due to the company have more liabilities than assets. On

[10] Source: Jay R. Ritter's "IPO Statistics for 2017 and Earlier Years" database, available at https://site.warrington.ufl.edu/ritter/ipo-data/. (accessed April 10, 2018)
[11] Source: Jay R. Ritter's "IPO Statistics for 2017 and Earlier Years" database, available at https://site.warrington.ufl.edu/ritter/ipo-data/. (accessed March 12, 2018)
[12] Source: Jay R. Ritter's "IPO Statistics for 2017 and Earlier Years" database, available at https://site.warrington.ufl.edu/ritter/ipo-data/. (accessed April 10, 2018)
[13] Source: Financial Industry Regulatory Authority (FINRA) website, available at http://www.finra.org/investors/5-biggest-us-ipos-all-time. (accessed April 13, 2018)

the other hand the highest B/M ratio was a 1.88. Average *LnGrossProceeds* and *Age* were 18.6 (std. dev. 0.91) and 3.40 (std. dev. 0.68), respectively. Furthermore, *Age* registered a maximum of 4.74 and 2.08 as a minimum.

Table 1. Distribution of number of tech IPOs listed in the U.S., average underpricing, average book-to-market, aggregate gross proceeds, number of Spread7, number of DualClass, number of HighR by year, 2010-2017

The number of total offers is based upon NASDAQ's database when selected for the technologic sector, further excluding companies offering ADR and issues with missing values. **Underpricing** is the difference between the first trading day closing market price and final offer price, dividing by the offer price. **Book-to-Market** is calculated as the net asset value per share before the IPO divided by the final offering price per share. **Gross Proceeds** calculations are based upon the amount sold in the U.S., excluding the possible proceeds from over-allotment options, it is expressed in terms of U.S. dollars of 2010 purchasing power by using the U.S. GDP implicit price deflator. **Spread7** represents IPOs that had a spread (underwriter fees per share divided by the offer price per share) equal to or greater than 7%. **DualClass** illustrates firms that performed an IPO with more than one class of shares. **HighR** represents IPOs where the lead underwriters had a average ranking higher than 8.501, such ranking ranges from 1.001 to 9.001 with 0.5 intervals and was extracted from Ritter's database.

Year	No. IPOs	Average Underpricing %	Average Book-to-Market	Aggregate Gross Proceeds ($ millions)	No. *Spread7*	No. *DualClass*	No. *HighR*
2010	7	16.9	0.68	1,014.8	6	1	2
2011	9	23.0	0.62	2,741.2	6	2	4
2012	15	22.0	0.27	17,184.6	13	1	9
2013	15	32.6	0.31	4,444.3	11	4	11
2014	27	28.7	0.45	4,045.3	24	2	14
2015	18	18.9	0.51	4,186.0	10	12	12
2016	15	34.3	0.52	1,344.5	15	5	8
2017	25	23.0	0.26	7,321.7	19	11	15
Total	131	26.0	0.42	42,282.4	104	38	75

Table 2. Descriptive statistics of non-dummy variables

The sample is composed by 131 IPOs from the tech industry listed in the U.S. during 2010-2017, companies offering ADR and issues with missing values were excluded. **Underpricing** is the difference between the first trading day closing market price and final offer price, dividing by the offer price. **BOOKtoMarket** is calculated as the net asset value per share before the IPO divided by the final offering price per share. **LnGrossProceeds** illustrates the natural logarithm of the gross proceeds, calculations are based upon the amount sold in the U.S., excluding the possible proceeds from over-allotment options, it is expressed in terms of U.S. dollars of 2010 purchasing power by using the U.S. GDP implicit price deflator. **Age**, in years, is the natural logarithm of 1 plus the difference between the year of IPO and the foundation date of the company, the latter was extracted from Ritter's database.

Variables	Mean	Std. Deviation	Minimum	Maximum
Underpricing	0.26	0.27	- 0.19	0.87
BOOKtoMarket	0.42	0.67	-1.14	1.88
LnGrossProceeds	18.6	0.91	16.5	20.4
Age	3.40	0.68	2.08	4.74

Table 3 contains the correlations among all studied variables, where the 5% critical value (two-tailed) equals to 0.1716. Thus any absolute value present on the matrix greater than 0.1716 suggests significant linear correlation. Equally important to mention that variance inflation factor (VIF), present on Annex D, indicated no evidence of significant collinearity in any of the regression variables.

Preliminary evidence provided in table 3 showed that *Underpricing* had an insignificant linear correlation with the majority of variables and that correlations orientation was opposite than hypothesized. Even though *LnGrossProceeds* (0.18) and *DualClass* (0.26) showed a significant positive correlation with underpricing, they were not in line with hypothesis H2 and H4, respectively.

Table 3. Coefficients Correlation Matrix

This correlation matrix (Pearson's product-moment correlation) uses 131 observations of tech IPOs listed in the U.S. during 2010-2017 (excluding ADR), it has a 5% critical value (two-tailed) equal to 0.1716. The dependent variable, **Underpricing**, is the difference between the first trading day closing market price and final offer price, dividing by the offer price. **BOOKtoMarket** is calculated as the net asset value per share before the IPO divided by the final offering price per share. **LnGrossProceeds** calculations are based upon the amount sold in the U.S., excluding the possible proceeds from over-allotment options, it is expressed in terms of U.S. dollars of 2010 purchasing power by using the U.S. GDP implicit price deflator. **Spread7** is a dummy variable that equal to 1 if the spread (underwriter fees per share divided by the offer price per share) is equal to or greater than 7%, and 0 otherwise. **DualClass** represent firms that performed an IPO with more than one class of shares. **HighR** represents a dummy variable that equals to the unity if the average of the lead underwriters ranking is strictly greater than 8.501 and 0 otherwise, such ranking ranges from 1.001 to 9.001 with 0.5 intervals and was extracted from Ritter's database. Control variable **Age**, in years, is the natural logarithm of 1 plus the difference between the year of IPO and the foundation date of the company, the latter was extracted from Ritter database. Control variable **Hot** is illustrated by a dummy variable that equals to the unity if the IPO occured in 2013 or 2014, and 0 otherwise.

Variables	*Underpricing*	*BOOKtoMarket*	*LnGrossProceeds*	*Spread7*	*DualClass*	*HighR*	*Age*	*Hot*
Underpricing	1.0000	-0.1018	0.1829	0.1011	0.2599	0.1303	0.1118	0.1166
BOOKtoMarket		1.0000	0.1392	-0.2464	0.0419	-0.0430	0.0474	-0.0187
LnGrossProceeds			1.0000	-0.7594	0.3166	0.3905	0.1474	-0.0372
Spread7				1.0000	-0.2149	-0.1733	-0.1586	0.0670
DualClass					1.0000	0.2123	0.1282	-0.2229
HighR						1.0000	0.0387	0.0315
Age							1.0000	-0.1032
Hot								1.0000

High ranked bookrunners (*HighR*) showed a positive significant correlation with *LnGrossProceeds* (0.39) and *DualClass* (0.21), which confirms Johnson and Miller (1988) results indicating that high ranked bookrunners being associated with lower

risk IPOs. Moreover, consistent with Carter's (1992) argument that prestigious underwriters are more likely to discount their spread, *HighR* had a significant negative correlation with *Spread7* (-0.17). Both findings might suggest that less riskier IPOs are associated with a lower spread. In fact, such negative linear significative correlation of *Spread7* with *LnGrossProceeds* (-0.76) and *DualClass* (-0.21) was found in table 3. However, when matching *Spread7* with *BOOKtoMarket* the result was a negative significant correlation (-0.25), casting doubt on hypothesis H1 suggestion of higher B/M ratio signaling riskier companies.

(ii) OLS regression

Table 4 presents three different OLS regression models, where the level of underpricing is the dependent variable. Model 1, shows results that *Spread7* and *HighR* are in line with hypothesis H3 and H5, respectively. Yet, the latter doesn't show statistical significance at conventional levels. Conversely, all *BOOKtoMarket* (not significant at conventional levels), *LnGrossProceeds* (1% statistic significance), *DualClass* (5% statistic significance) had outcomes that are not in line with hypothesis H1, H2 and H4, respectively.

Furthermore, when control variables *Age* and *Hot* were added to the regression (Model 2), majority of variables of interest had their explanatory effect increased and an increase occurred on the Adjusted R^2 (from 0.181 to 0.204). *LnGrossProceeds* and *Spread7* reacted differently to the control variables and registered a decrease on the coefficients (from 0.164 to 0.159) and (from 0.361 to 0.359), respectively. Additionally, the control variable *Hot* is positively related to underpricing and significant at the 10% level.

The results in model 2 are in line with hypothesis H3, since IPOs with larger spreads register on average a higher underpricing. The result is significant at the 1% level.

Model 2 also report that, *LnGrossProceeds* is positively significant at the 1% level. This result is not in line with hypothesis H2, and contradicts both Beatty & Ritter's (1986) and Ritter's (1987) argument that investors perceiving smaller offer size IPOs as more risky than larger new issues. Yet, this result is not unique in the

literature. Similar result was suggested by Daily et al. (2003) in their meta-analysis. However they did not attempt to rationalize on the results. Loughran and Ritter (2004) documented an increasing trend of IPOs from firms with negative earnings. In fact, just 60%[14] of the IPOs listed in the U.S. from 2010-2017 were profitable, a number that decreases to 33%[15] when focusing on tech companies. Moreover, every year from 2010 to 2017 registered average gross proceeds per IPO greater than during 1980-2017[16]. Both facts combined might partly explain the contrast between hypothesis H1 (derived upon studies from the 80s), and the results reported on model 2. Since it suggests that riskier companies (i.e., firms with negative earnings) are nowadays associated with larger IPO offer sizes.

Moreover, model 2 suggests that *DualClass* is positively related to underpricing and significant at the 1% level. A result that is not in line with H4. However, under Ritter's (1984) *ex-ante* uncertainty arguments, one might infer from Chemmanur and Jiao's (2012) that IPOs with dual-class shares are associated with riskier issues, thereby with higher underpricing. An inference that is in line with the results obtained in model 2. Furthermore and still under Ritter's (1984) *ex-ante* uncertainty arguments, Chemmanur and Jiao (2012) additionally suggested that dual-class IPOs are likely to underprice more (less) than single-class IPOs when the entrepreneur's reputation is high (low) and when the firm operates in an industry with a large (small) difference in intrinsic values between projects with high and low short-term uncertainty. If one combines the latter suggestions with the significant positive correlation between *Underpricing* and *DualClass* (0.26), observed in table 3, one can argue that tech industry has a large difference in intrinsic values between projects with high and low short-term uncertainty. A large difference that might be due to the fact that "technological innovations entail a long gestation period and provide few interim signals (e.g., cash flows) on its outcomes" (Francis et al., 2012).

[14] Source: Jay R. Ritter's "IPO Statistics for 2017 and Earlier Years" database, available at https://site.warrington.ufl.edu/ritter/ipo-data/. (accessed May 3, 2018)
[15] Source: Jay R. Ritter's "IPO Statistics for 2017 and Earlier Years" database, available at https://site.warrington.ufl.edu/ritter/ipo-data/. (accessed May 3, 2018)
[16] Source: Jay R. Ritter's "IPO Statistics for 2017 and Earlier Years" database, available at https://site.warrington.ufl.edu/ritter/ipo-data/. (accessed May 4, 2018)

Table 4. OLS Regression

Both Models 1, 2 and 3 have **Underpricing** as dependent variable. OLS regressions are estimated using heteroskedasticity-robust standard errors (variant HC1). Sample consist on 131 tech IPOs listed on the U.S. between 2010-2017, companies offering ADR and issues with missing values were excluded. **Underpricing** is the difference between the first trading day closing market price and final offer price, dividing by the offer price. **BOOKtoMarket** is calculated as the net asset value per share before the IPO, divided by the final offering price per share. **LnGrossProceeds** calculations are based upon the amount sold in the U.S., excluding the possible proceeds from over-allotment options, it is expressed in terms of U.S. dollars of 2010 purchasing power by using the U.S. GDP implicit price deflator. **Spread7** is a dummy variables that equal to 1 if the spread (underwriter fees per share divided by the offer price per share) is equal or greater than 7%, and 0 otherwise. **DualClass** represent firms that performed an IPO with more than one class of shares. **HighR** represents a dummy variable that equals to the unity if the average of the lead underwriters ranking is strictly greater than 8.501 and 0 otherwise, such ranking ranges from 1.001 to 9.001 with 0.5 intervals and was extracted from Ritter's database. Control variable **Age**, in years, is the natural logarithm of 1 plus the difference between the year of IPO and the foundation date of the company, the latter was extracted from Ritter database. Control variable **Hot** is illustrated by a dummy variable that equals to the unity if the IPO occured in 2013 or 2014, and 0 otherwise. *, **, *** Significant at the 10 percent, 5 percent and 1 percent levels, respectively (two-tailed tests).

		Model 1		Model 2		Model 3	
Variables	Predicted Sign	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Constant		-3.090	-3.543 ***	-3.171	-3.672 ***	-2.817	-2.936 ***
BOOKtoMarket	H1 (+)	-0.022	-0.764	-0.023	-0.824	-0.038	-0.989
LnGrossProceeds	H2 (-)	0.164	3.714 ***	0.159	3.665 ***	0.146	3.082 ***
Spread7	H3 (+)	0.361	4.132 ***	0.359	4.179 ***	0.334	3.511 ***
DualClass	H4 (-)	0.125	2.385 **	0.143	2.723 ***	0.193	3.268 ***
HighR	H5 (-)	-0.021	-0.492	-0.026	-0.602	-0.025	-0.495
Control Variables							
Age				0.043	1.255	0.013	0.321
Hot				0.095	1.844 *	0.096	1.703 *
N		131		131		98	
SER		0.242		0.239		0.244	
R^2		0.212		0.247		0.259	
Adjusted R^2		0.181		0.204		0.201	

Conversely, *HighR* (hypothesis H5) and *BOOKtoMarket* (hypothesis H1) are not significant at conventional levels. The negative relation between *HighR* and underpricing is in line with hypothesis H5, but the lack of significance is certainly not. Hypothesis H5 was derived upon results obtained by studies from the late 80s and early 90s, which can be part of the explanation. Park et al. (2016) argued that constant advances on information technology and regulatory changes concerning the quiet period prior IPO, resulted in an access to "rich fine-grained" information and

on the “democratization of IPO-related information”. Information availability, on one hand may lead to a reduction of information asymmetry between investors, while on the other hand it may increase the hype surrounding an IPO, making it difficult to estimate demand, thus impacting how IPOs are priced (Park et al., 2016). Therefore, the significance of *HighR* as a signal for less risky IPOs might been reduced partially due to a direct consequence of wider IPO related information availability. As a consequence, the increasing difficulty on predicting IPO demand might partially explain the reduction on the explanation power of *HighR* on underpricing. Additionally, I verified a constant increase on the amount of IPOs with multiple lead underwriters, 0%[17] in the 80s, 0.9%[18] in the 90s, 46%[19] in the 00s and 90%[20] from 2010 to 2017. A similar trend was registered in the tech industry, from 2010 to 2017 86% of the IPOs had multiple bookrunners. If combined with the continuous increase of regulatory scrutiny, one might suggest that unethical or illegal behaviour from underwriters (i.e., manipulate IPO underpricing for their own direct or indirect benefit, for example “spinning”) has decreased. Thus might reduce the impact of *HighR* on underpricing.

I found evidence that 25% of the tech companies listed in the U.S. from 2010-2017 had a negative asset value before IPO. This fact might partly explain the lack of statistical significance of the regressor *BOOKtoMarket*. Peterkort and Nielsen (2005) suggested that the inclusion of negative equity firms generally decreases the relative explanatory power of B/M ratio on average stock returns. Indeed, the *BOOKtoMarket* explanatory power increased when regressing a model without negative equity firms (Model 3). However it was not significant at conventional levels. Park (2017) documented that growth in intangible assets and the associated valuation challenges were a reason for the weakened B/M effect observed in their study. Combining the latter with Kim and Pukthuanthong-Le’s (2008) suggestion on

[17] Source: Jay R. Ritter’s “IPO Statistics for 2017 and Earlier Years” database, available at https://site.warrington.ufl.edu/ritter/ipo-data/. (accessed May 2, 2018)
[18] Source: Jay R. Ritter’s “IPO Statistics for 2017 and Earlier Years” database, available at https://site.warrington.ufl.edu/ritter/ipo-data/. (accessed May 2, 2018)
[19] Source: Jay R. Ritter’s “IPO Statistics for 2017 and Earlier Years” database, available at https://site.warrington.ufl.edu/ritter/ipo-data/. (accessed May 2, 2018)
[20] Source: Jay R. Ritter’s “IPO Statistics for 2017 and Earlier Years” database, available at https://site.warrington.ufl.edu/ritter/ipo-data/. (accessed May 2, 2018)

tech firms having typically many intangible assets, one may further explain the lack of statistical significance observed on *BOOKtoMarket*.

V. Conclusions

This thesis investigated the impact of the information contained on the prospectus summary on the underpricing. In a sample of 131 tech IPOs, a 26% underpricing was observed for the period 2010-2017. This is a larger value than for non-tech firms. Furthermore, it was provided evidence that IPOs with larger underwriter spreads are associated with more underpricing, that IPOs with larger gross proceeds and dual-class shares underprice less and that book-to-market ratio and underwriter reputation do not have significant impact on IPO underpricing.

A great majority of the results challenged the hypothesis derived upon previous literature. I argued that such may be partly attributed to the inherent specifications of the tech industry, advances on information technology, continuous regulatory changes, increase on regulatory scrutiny and changes on U.S. IPO market trends. Nevertheless, I did not think that those are the only explanation for the patterns documented in this thesis. Yet, it does consist of a reasonable empirical and theoretical framework, within which it is possible to formulate and empirically test hypotheses, as future research on underpricing proceeds.

Therefore, it would be interesting to see future research taking into consideration the continuous developments of information technology and attempting to estimate its impact on information asymmetry among IPOs agents. Since the latter consists in the main argument of fundamental underpricing theories such as “winner's curse” and “signaling theory”.

All in all, the results obtained in this thesis are in line with a stream of contradictory and inconsistent results reported within the underpricing literature. This highlights the need to encourage change on how relevant questions are specified and how study methods are conducted within the topic.

Annex A - "Facebook Inc." final prospectus summary available at https://www.sec.gov/Archives/edgar/data/1326801/000119312512240111/d287954d424b4.htm#toc (accessed on March 18, 2018).

Filed Pursuant to Rule 424(b)(4)
Registration No. 333-179287

PROSPECTUS

421,233,615 Shares

facebook

CLASS A COMMON STOCK

Facebook, Inc. is offering 180,000,000 shares of its Class A common stock and the selling stockholders are offering 241,233,615 shares of Class A common stock. We will not receive any proceeds from the sale of shares by the selling stockholders. This is our initial public offering and no public market currently exists for our shares of Class A common stock.

We have two classes of common stock, Class A common stock and Class B common stock. The rights of the holders of Class A common stock and Class B common stock are identical, except voting and conversion rights. Each share of Class A common stock is entitled to one vote. Each share of Class B common stock is entitled to ten votes and is convertible at any time into one share of Class A common stock. The holders of our outstanding shares of Class B common stock will hold approximately 96.0% of the voting power of our outstanding capital stock following this offering, and our founder, Chairman, and CEO, Mark Zuckerberg, will hold or have the ability to control approximately 55.9% of the voting power of our outstanding capital stock following this offering.

Our Class A common stock has been approved for listing on the NASDAQ Global Select Market under the symbol "FB."

We are a "controlled company" under the corporate governance rules for NASDAQ-listed companies, and our board of directors has determined not to have an independent nominating function and instead to have the full board of directors be directly responsible for nominating members of our board.

Investing in our Class A common stock involves risks. See "Risk Factors" beginning on page 12.

PRICE $38.00 A SHARE

	Price to Public	Underwriting Discounts and Commissions	Proceeds to Facebook	Proceeds to Selling Stockholders
Per share	*$38.00*	*$0.418*	*$37.582*	*$37.582*
Total	*$16,006,877,370*	*$176,075,651*	*$6,764,760,000*	*$9,066,041,719*

We and the selling stockholders have granted the underwriters the right to purchase up to an additional 63,185,042 shares of Class A common stock to cover over-allotments.

The Securities and Exchange Commission and state regulators have not approved or disapproved of these securities, or determined if this prospectus is truthful or complete. Any representation to the contrary is a criminal offense.

The underwriters expect to deliver the shares of Class A common stock to purchasers on May 22, 2012.

MORGAN STANLEY *J.P. MORGAN* *GOLDMAN, SACHS & CO.*

BofA MERRILL LYNCH *BARCLAYS* *ALLEN & COMPANY LLC*

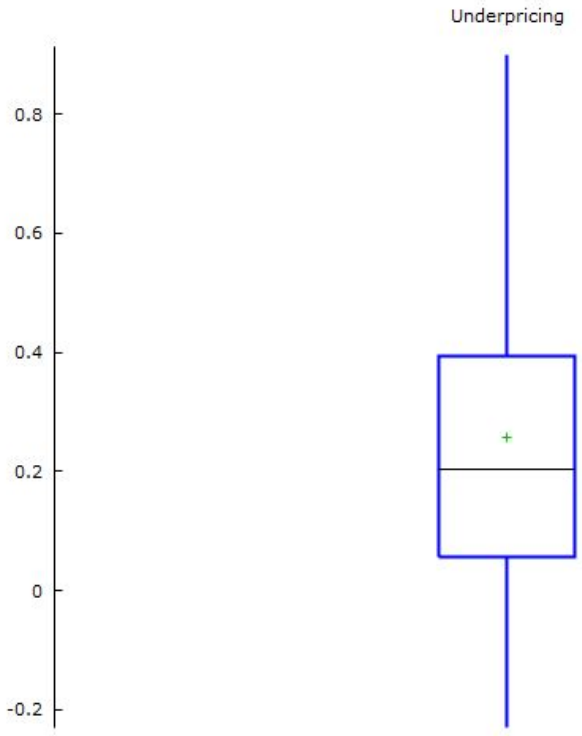
CITIGROUP *CREDIT SUISSE* *DEUTSCHE BANK SECURITIES*

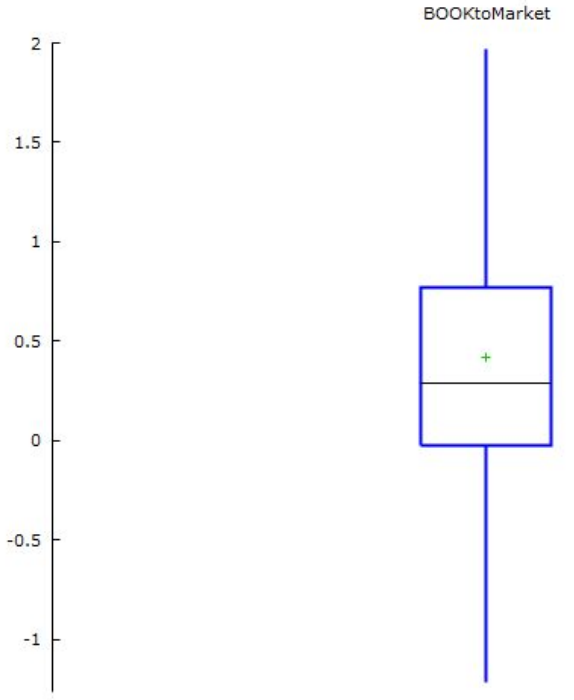
RBC CAPITAL MARKETS *WELLS FARGO SECURITIES*

May 17, 2012

Annex B - Boxplots of non-dummy variables, U.S. tech IPOs 2010-2017

The follow 4 graphs are the boxplots computed after the winsorization of 33 outliers across the 4 different variables, it contains 131 observariotions. The green dot represents the mean and the black line the mediane. The sample consists on tech IPOs listed in the U.S. between 2010-2017, where ADRs are excluded. Underpricing is the difference between the first trading day closing market price and final offer price, dividing by the offer price. BOOKtoMarket is calculated as the net asset value per share before the IPO divided by the final offering price per share. LnGrossProceeds calculations are based upon the amount sold in the U.S., excluding the possible proceeds from over-allotment options, it is expressed in terms of U.S. dollars of 2010 purchasing power by using the U.S. GDP implicit price deflator. Age, in years, is the natural logarithm of 1 plus the difference between the year of IPO and the foundation date of the company, the latter was extracted from Jay R. Ritter database.

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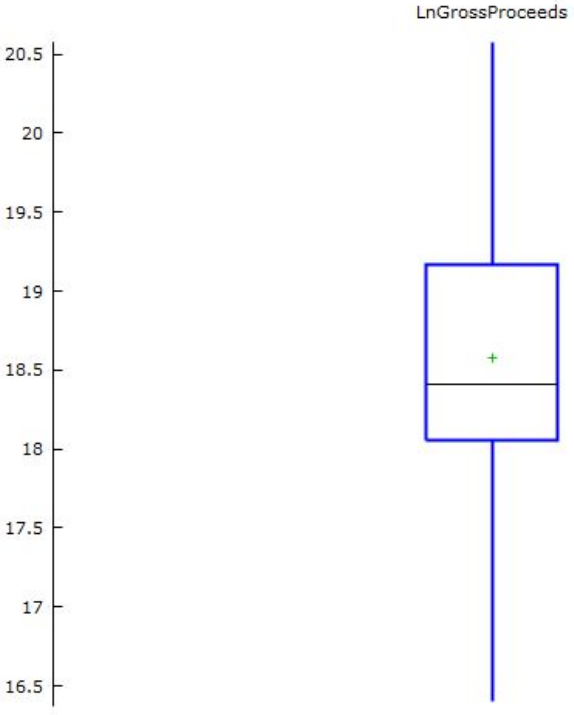
-1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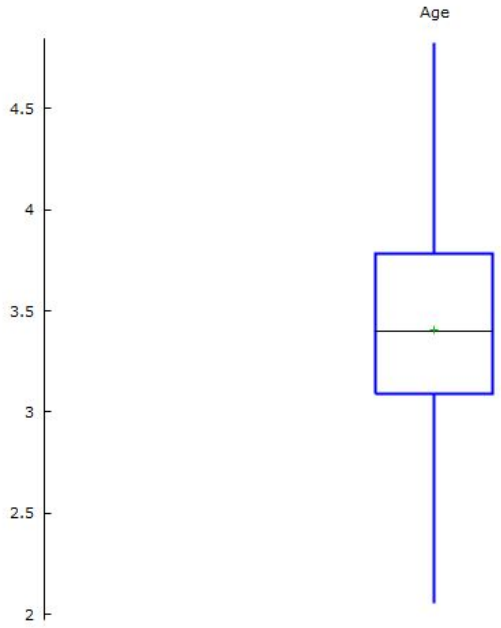
17.5
17
16.5



Annex C - “Founding dates for firms going public in the U.S. during 1975-2017 (updated January 2018)”

“There is some subjectivity in deciding what year a company was founded for some firms. For instance, assume a company started as a partnership with the name of the Field Co. in 1965, incorporated in Florida in 1967, reincorporated in 1974 in Delaware under the name Field Computer Co., merged in 1982 with the Ritter Co. (which had been founded in 1957), and went public in 1983 as the Field Computer Co. We would deem the founding date to be 1965. But if the name had been changed to the Field-Ritter Computing Co. when the merger occurred in 1982, we would deem the founding date to be 1957, the older of the two merged companies. For many firms that were founded before 1900, the founding date is listed as 1900 or 1901. Thus, founding dates of 1900 or 1901 should be treated as no later than these dates. I use an if-then statement that caps the age at 80 years.

Reverse LBOs are given a founding date for the predecessor company. So if the Field Flying Widget Co. was founded in 1960 as the Field Widget Co., went public in 1968, went private in 1986 and changed its name to the Field Flying Widget Co., and then went public again in 1992 as the Field Flying Widget Co., we would give a founding date of 1960.” All text was cited by Ritter on its “Founding dates for firms

going public in the U.S. during 1975-2017 (updated January 2018)" database, available at https://site.warrington.ufl.edu/ritter/ipo-data/ (accessed March 22, 2018).

Annex D - Collinearity tests

The following tests were performed on Gretl, hence the format of the output.

```
Variance Inflation Factors
Minimum possible value = 1.0
Values > 10.0 may indicate a collinearity problem

   BOOKtoMarket    1.076
LnGrossProceeds    2.940
        Spread7    2.592
      DualClass    1.193
          HighR    1.254
            Age    1.042
            Hot    1.069

VIF(j) = 1/(1 - R(j)^2), where R(j) is the multiple correlation coefficient
between variable j and the other independent variables

Belsley-Kuh-Welsch collinearity diagnostics:

                      --- variance proportions ---
    lambda      cond     const BOOKtoMa~ LnGrossP~   Spread7 DualClass     HighR       Age       Hot
     5.209     1.000     0.000     0.009     0.000     0.002     0.006     0.009     0.001     0.006
     0.869     2.449     0.000     0.037     0.000     0.000     0.211     0.000     0.000     0.561
     0.819     2.522     0.000     0.094     0.000     0.004     0.362     0.015     0.000     0.257
     0.635     2.863     0.000     0.722     0.000     0.011     0.102     0.001     0.001     0.005
     0.317     4.051     0.000     0.003     0.000     0.015     0.119     0.865     0.001     0.098
     0.134     6.227     0.000     0.074     0.000     0.269     0.087     0.079     0.028     0.003
     0.015    18.445     0.005     0.019     0.007     0.016     0.004     0.011     0.956     0.017
     0.000   148.375     0.995     0.041     0.993     0.683     0.108     0.021     0.014     0.054

  lambda = eigenvalues of X'X, largest to smallest
  cond   = condition index
```

References

Aruğaslan, O., Cook, D., & Kieschnick, R. (2004). Monitoring as a Motivation for IPO Underpricing. Journal of Finance, 59(5), 2403-2420.

Arugaslan, Cook, & Kieschnick. (2010). On the decision to go public with dual class stock. Journal of Corporate Finance, 16(2), 170-181.

Beatty, & Ritter. (1986). Investment banking, reputation, and the underpricing of initial public offerings. Journal of Financial Economics, 15(1), 213-232.

Berk, J., & DeMarzo, P. (2014). Corporate finance (3. ed., global ed., Pearson series in finance).

Boulton, T., Smart, S., & Zutter, C. (2017). Conservatism and international IPO underpricing. Journal of International Business Studies, 48(6), 763-785.

Brennan, & Franks. (1997). Underpricing, ownership and control in initial public offerings of equity securities in the UK. Journal of Financial Economics, 45(3), 391-413.

Carter, R. (1992). UNDERWRITER REPUTATION AND REPETITIVE PUBLIC OFFERINGS. Journal of Financial Research, 15(4), 341-354.

Carter, R., Dark, F., & Singh, A. (1998). Underwriter Reputation, Initial Returns, and the Long-Run Performance of IPO Stocks. The Journal of Finance, 53(1), 285-311.

Carter, R., & Manaster, S. (1990). Initial Public Offerings and Underwriter Reputation. Journal of Finance, 45(4), 1045-1067.

Certo, S., Covin, J., Daily, C., & Dalton, D. (2001). Wealth and the effects of founder management among IPO-stage new ventures. Strategic Management Journal, 22(Supp.), 641-658.

Chen, C., & Mohan, N. (2002). Underwriter Spread, Underwriter Reputation, and IPO Underpricing: A Simultaneous Equation Analysis. Journal of Business Finance & Accounting, 29(3-4), 521-540.

Chen, H., & Ritter, J. (2000). The Seven Percent Solution. Journal of Finance, 55(3), 1105-1131

Chemmanur, Thomas J., & Jiao, Yawen. (2012). Dual class IPOs: A theoretical analysis.(Report). Journal of Banking & Finance, 36(1), 305-319.

Cohen, B., & Dean, T. (2005). Information asymmetry and investor valuation of IPOs: Top management team legitimacy as a capital market signal. Strategic Management Journal, 26(7), 683-690.

Daily, Certo, & Dalton. (2005). Investment bankers and IPO pricing: Does prospectus information matter? Journal of Business Venturing, 20(1), 93-111.

Daily, C., Trevis Certo, S., Dalton, D., & Roengpitya, R. (2003). IPO Underpricing: A Meta-Analysis and Research Synthesis. Entrepreneurship Theory and Practice, 27(3), 271-295.

Fama, Eugene F., & French, Kenneth R. (1992). The cross-section of expected stock returns. (includes appendix). Journal of Finance, 47(2), 427.

Filatotchev, I., & Bishop, K. (2002). Board composition, share ownership, and 'underpricing' of U.K. IPO firms. Strategic Management Journal, 23(10), 941-955.

Francis, B., Hasan, I., & Zhou, M. (2012). Strategic Conservative Earnings Management of Technology Firms: Evidence from the IPO Market. Financial Markets, Institutions & Instruments, 21(5), 261-293.

Garner, & Marshall. (2010). The non-7% solution. Journal of Banking and Finance, 34(7), 1664-1674.

Grinblatt, M., & Hwang, C. (1989). SIGNALING AND THE PRICING OF NEW ISSUES. Journal Of Finance, 44(2), 393-420.

Hanley, K., & Hoberg, G. (2010). The Information Content of IPO Prospectuses. The Review of Financial Studies, 23(7), 2821-2864.

Hansen, R. (2001). Do investment banks compete in IPOs?: The advent of the "7% plus contract". Journal of Financial Economics, 59(3), 313-346.

Holmén, M., & Wang, P. (2015). Pyramid IPOs on the Chinese Growth Enterprise Market. Emerging Markets Finance and Trade, 1-14.

Hopp, C., & Dreher, A. (2013). Do differences in institutional and legal environments explain cross-country variations in IPO underpricing? Applied Economics, 45(4), 435-454.

Iannotta, G., & SpringerLink. (2010). Investment Banking A Guide to Underwriting and Advisory Services. Berlin, Heidelberg: Springer Berlin Heidelberg.

Ibbotson, R., & Jaffe, J. (1975). 'Hot issue' markets. Journal of Finance, 30(4), 1027-1042.

Ibbotson, & Ritter. (1995). Chapter 30 Initial public offerings. Handbooks in Operations Research and Management Science, 9(C), 993-1016.

Jain, B., & Kini, O. (1999). The Life Cycle of Initial Public Offering Firms. Journal of Business Finance & Accounting, 26(9-10), 1281-1307.

Johnson, J., & Miller, R. (1988). Investment Banker Prestige and the Underpricing of Initial Public Offerings. Financial Management, 17(2), 19-29.

Johnston, J., & Madura, Jeff. (2000). The Impact of Industry -specific Variables on the Performance of Initial Public Offerings, ProQuest Dissertations and Theses.

Kim, J., Pukthuanthong-Le, K., & Walker, T. (2008). Leverage and IPO under-pricing: High-tech versus low-tech IPOs. Management Decision, 46(1-2), 106-130.

Leone, A., Rock, S., & Willenborg, M. (2007). Disclosure of Intended Use of Proceeds and Underpricing in Initial Public Offerings. Journal of Accounting Research, 45(1), 111-153.

Loughran, T. & Ritter, J. R. (2002). Why don't issuers get upset about leaving money on the table in IPOs? Review of Financial Studies, 15(2), 413–443.

Loughran, T., & Ritter, J. (2004). Why Has IPO Underpricing Changed Over Time? Financial Management, 33(3), 5-37.

Megginson, W. L., & Weiss, K. A. (1991). Venture capitalist certification in initial public offerings. Journal of Finance, 46, 879-903.

Nguyen, H., Dimovski, W., & Brooks, R. (2010). Underpricing, risk management, hot issue and crowding out effects: Evidence from the Australian resources sector initial public offerings. Review of Pacific Basin Financial Markets and Policies, 13(3), 333-362.

Park, H. (2017). Intangible assets and the book-to-market effect. European Financial Management, 1–30.

Park, H., & Patel, P. (2015). How Does Ambiguity Influence IPO Underpricing? The Role of the Signalling Environment. Journal of Management Studies, 52(6), 796-818.

Park, U., Borah, A., & Kotha, S. (2016). Signaling revisited: The use of signals in the market for IPOs. Strategic Management Journal, 37(11), 2362-2377.

Peterkort, R., & Nielsen, J. (2005). IS THE BOOK-TO-MARKET RATIO A MEASURE OF RISK? Journal of Financial Research, 28(4), 487-502.

Rajan, R., & Servaes, H. (1997). Analyst Following of Initial Public Offerings. The Journal of Finance, 52(2), 507-529.

Ritter, J. (1984). The "Hot Issue" Market of 1980. The Journal of Business (pre-1986), 57(2), 215.

Ritter, J. (1987). The costs of going public. Journal of Financial Economics, 19(2), 269-281.

Ritter, J. (1991). The long-run performance of initial public offerings. The Journal of Finance : The Journal of the American Finance Association, 46(1), 3-27.

Ritter, J. (2003). Differences between European and American IPO Markets. European Financial Management, 9(4), 421-434.

Ritter, J. & Welch, I. (2002). A review of IPO activity, pricing, and allocations. Journal of Finance, 57, 1795–1828.

Rock, K. (1986). Why new issues are underpriced. Journal of Financial Economics,15(1), 187-212.

Seguin, & Smoller. (1997). Share price and mortality: An empirical evaluation of newly listed Nasdaq stocks. Journal of Financial Economics, 45(3), 333-363.

Smart, & Zutter. (2003). Control as a motivation for underpricing: A comparison of dual and single-class IPOs. Journal of Financial Economics, 69(1), 85-110.

Spence, M. (1973). Job market signaling. Quarterly Journal of Economics, 87(3), 355-374.

Tukey, J. (1962). The Future of Data Analysis. Ann. Math. Statist., 33(1), 1-67.

Welch, I. (1989). Seasoned Offerings, Imitation Costs, and the Underpricing of Initial Public Offerings. Journal of Finance, 44(2), 421-449.

Zingales, L. (1995). Insider ownership and the decision to go public. Review of Economic Studies, 62, 425–448.