LUISS

Department of Business and Management
Double Degree in International Management (DDIM)

Chair of Corporate Governance

Analyzing the impact of innovation on Initial Public Offering underpricing: evidence from Chinese high-tech sector

Prof. Giovanni Fiori
SUPERVISOR

Prof. Jonathan Berkovitch
CO-SUPERVISOR

Gianluca Di Vizio
CANDIDATE

Academic Year 2022/2023

Table of Contents

Table of Tables

摘要

这项学术研究深入探讨了中国市场中的创新和首次公开募股(IPO)抑价之间的关系。分析主要关注创新代理的影响，即研发(R&D)专利的强度和数量，对 IPO 抑价的影响。研究假设通过回归分析进行测试，揭示出重要的见解。

结果表明，IPO 抑价与 R&D 强度呈正相关，这意味着具有更高 R&D 投资经验的公司有更大的 IPO 抑价。相反的是，IPO 抑价与专利数量之间存在负相关，这表明拥有更多专利的公司往往具有较低的 IPO 抑价。这些研究结果与研究假设相一致，且在回归分析中仍具有统计学意义。

分析研究扩展到公司规模对 IPO 抑价的影响，根据总资产将公司分为大、中、小三种类型。研究结果揭示了在不同规模的类别中创新与 IPO 折价之间微妙的关系。例如，在大公司中，R&D 强度与 IPO 抑价之间的正相关关系减弱，R&D 强度的显著性降低。中等规模公司则显示出 R&D 强度与 IPO 抑价之间的存在中等的相关性，而小公司表现出最小的可预测性。

总之，本研究强调了创新对中国市场 IPO 抑价产生的重要影响。它强调了 R&D 投资和专利投资组合在塑造抑价结果方面的作用。此外，创新投入和产出之间的关系可能会随着企业规模的不同而变化。这些发现有助于更深层次地理解在创新驱动的高科技公司背景下的 IPO 抑价动态。然而，这依旧存在一定的局限性，如对特定行业的关注和研发强度的测量需要进一步的研究，以探索在不同行业和不同监管环境下会产生的关系变化。此外，考虑到中国市场不断发展的政策和监管，这可能为未来 IPO 抑价和创新的动态提供有价值的见解。

关键词；创新，首次公开募股，IPO 抑价，研究与开发，专利，信息不对称

中图分类号：F830

Abstract

This academic study delves into the relationship between innovation and Initial Public Offering (IPO) underpricing in the Chinese market. The analysis primarily focuses on the impact of innovation proxies, namely Research and Development (R&D) Intensity and the number of patents, on IPO underpricing. The research hypotheses are tested using regression analysis, revealing significant insights.

The results indicate a positive correlation between IPO underpricing and R&D Intensity, suggesting that companies with higher Innovation input experience greater IPO underpricing. Conversely, a negative correlation is observed between IPO underpricing and the number of patents, indicating that companies with higher Innovation output tend to have lower IPO underpricing. These findings are consistent with the research hypotheses and remain statistically significant in the regression analysis.

The analysis extends to investigate the effects of firm size on IPO underpricing, categorizing companies into Large, Medium, and Small based on Total Assets. The findings reveal nuanced relationships between innovation and IPO underpricing within different size categories. For instance, in Large companies, the positive correlation between R&D Intensity and IPO underpricing weakens, while the significance of R&D Intensity diminishes. Medium-sized companies show a moderate correlation between R&D Intensity and IPO underpricing, while small companies exhibit minimal predictability.

In conclusion, this study underscores the significant influence of innovation on IPO underpricing in the Chinese market. It highlights the role of R&D investment and patent portfolios in shaping underpricing outcomes. Moreover, it suggests that the relationship between innovation input and output may vary with firm size. These findings contribute to a deeper understanding of IPO underpricing dynamics in the context of innovation-driven high-tech companies. However, certain limitations, such as the focus on a specific industry and the measurement of innovation, call for further research to explore these relationships in different industries and under various

regulatory environments. Additionally, considering the evolving policies and regulations in the Chinese market could provide valuable insights into the future dynamics of IPO underpricing and innovation.

Keywords: *Innovation, Initial Public Offering, IPO underpricing, R&D, Patent, Information asymmetry*.

CLC Number: F830

1. Introduction

1.1 Introduction

The study of innovation in the business environment is among the most popular topics according to scholars, researchers, and universities. Indeed, innovation is one of the key elements that affect the competitiveness of a business (Neely, 2005). However, despite the proven benefits that innovation brings to corporations, it is still a source of heated debate which are its drivers in the context of financial valuation.

In the emerging knowledge economy, the capability to innovate at the firm, regional, and national level, dictates the ability to generate wealth for an entire economy. Focusing on the firm level, numerous empirical studies suggest that innovation enhances firm performance, and it does so because the product of innovation increases firm competitiveness and the process of innovation transforms a firm's internal capabilities making it more adaptive to change.

Nonetheless, innovation is hard to measure due to its multi-dimensional character (Neely, 2005). Additionally, because innovation is context-specific, it is challenging to compare data. Two innovations are such even if the economic effects they produce are distinctly different. For example, innovation in the design of a simple paperclip and innovation in microprocessors are both counted as innovations (Neely, 2005).

Coming then to the subject matter of this thesis, in the literature it is possible to find a certain link between innovation and the moment at which the company decides to go public. There are several types of research that have shown that listing the company in financial markets, especially in highly developed ones such as the United States, allows the latter to foster innovation (Brown et al., 2009; Hsu et al., 2014).

Moreover, at times when creativity is at its peak and the company is at its highest levels of success in innovation, it tends to decide to opt for a listing (Bernstein, 2015; Pástor and Veronesi, 2009; Hsu et al., 2014).

The valuation of IPOs is of great theoretical and practical significance, especially in dynamic countries where IPOs thrive and are the primary source of economic development. Therefore, it is crucial to get a full grasp of how businesses that have just entered the financial markets are valued.

The limited information about the company and its prospects that are made accessible to the general public at the time of the IPO presents a special challenge to its valuation. The firms going public typically lack established histories of sales, earnings, or cash flows; the issuers' current assets are typically insignificant; and for high-tech companies, the main assets are intangibles (such as patents, trademarks, and alliances), which are notoriously difficult to value (Guo et al., 2005).

An aspect that has not, however, been covered by the literature on innovation and IPO underpricing is whether the results of the models applied to determine the relationships between the innovation variables and the IPO valuation and performances vary with the size of the companies carrying out those investments. In this way, it would be possible to shed light and provide useful conclusions in the field of "effectiveness" of investments in research and development implemented by companies of varying sizes, and how these impact underpricing in the IPO phase.

Prior IPO valuation studies looked at three groups of potential value drivers such as financial fundamentals, like sales, earnings, and R&D expenditures; nonfinancial information on managerial actions taken by firms, like acquisitions, new products, and alliances (Rajgopal et al. 2002; Bartov et al. 2002); and various firm and issue attributes, like the stake retained by pre-IPO owners, presumably signaling firm value to investors (Leland and Pyle, 1977). The study on IPO valuation, however, is especially limited when it comes to the second group of value determinants, nonfinancial elements. The nonfinancial factors are likely the key to understanding the value of IPOs, despite the fact that the earnings, cash flows, and physical assets of the majority of IPOs are typically small.

1.2 Potential Contribution of the Research

A research study based on the provided paragraph offers substantial potential contributions to the academic discourse on Initial Public Offerings (IPOs) and their relationship with innovation, with a particular focus on the high-technology sector, notably within the Chinese market context.

The study's primary objectives involve empirically elucidating the influences of innovation-related variables, specifically Research and Development (R&D) intensity and the number of patents, on the extent of IPO underpricing within high-tech firms. By presenting empirical evidence, this research strengthens the theoretical foundations and practical understanding of how innovation shapes the dynamics of IPOs.

Furthermore, the study extends the application of information asymmetry theory to the context of IPO underpricing in high-technology enterprises, shedding new light on the role of information disclosure and innovation in mitigating information asymmetry.

An unexplored aspect within the existing body of literature on innovation and IPO underpricing pertains to the potential variations in the outcomes of applied models used to shed light to the associations between innovation variables and IPO valuation and performance, contingent upon the size of the enterprises executing these investments. This offers the opportunity to unveil significant insights and offer substantiated conclusions in the realm of the "effectiveness" of research and development investments undertaken by companies of diverse magnitudes. Furthermore, it enables a comprehensive examination of how these investments exert influence on underpricing during the pivotal IPO phase.

Moreover, the division of the sample into distinct size categories offers a nuanced perspective on the influence of innovation on underpricing, catering to the diverse needs of investors and firms contemplating IPOs. Lastly, the suggestion for future comparative analysis across different regions or industries and the emphasis on methodological considerations paves the way for comprehensive and refined research endeavors in this domain.

2. Literature Review

Through a thorough analysis of the relevant literature, the study accurately describes and analyzes the variables considered, and forecasts the research hypotheses.

2.1 About the Definition of "Innovation"

The term 'innovation' is widely acknowledged for its inherent ambiguity and the absence of a singular, universally accepted definition or metric (Adams et al., 2006). In general, innovation is often characterized as the process of introducing novel systems, regulations, methods of production, or other elements that bring about substantial modifications or revitalization within the realms of politics, society, production techniques, or any relevant domain. However, this overarching definition of innovation fails to elucidate its specific manifestations and applications across various academic disciplines and practical contexts.

To address this issue, it becomes imperative to explore a range of definitions that encompass diverse facets of innovation, some of which are tailored to particular fields, thereby illustrating the multifaceted nature of innovation. For instance, Thompson's (1965) succinct definition defines innovation as the generation, acceptance, and implementation of new ideas, processes, products, or services. A more contemporary perspective by West and Anderson (1996) characterizes innovation as the effective application of new processes and products within an organization, designed to benefit both the organization itself and its stakeholders.

Kimberly (1981) introduces a comprehensive perspective on innovation, highlighting its existence in three distinct stages: innovation as a process, innovation as discrete items (including products, programs, or services), and innovation as an attribute inherent to organizations. Certain scholars underscore the importance of novelty, as posited by Van de Ven et al. (1986), who assert that an idea qualifies as an 'innovation' as long as it is perceived as new by those involved, regardless of its resemblance to existing concepts.

Incorporating the notions of change and novelty, Damanpour (1996) offers a frequently referenced definition, framing innovation as a means of altering an organization, whether in response to external environmental shifts or as a proactive strategy to influence the environment. Accordingly, innovation encompasses a spectrum of types, including new products or services, advancements in process technology, novel organizational structures or administrative systems, and innovative plans or programs related to organizational members.

In the context of technological innovation, definitions tend to focus on the development of products associated with new technology (Nord and Tucker, 1987). It is noteworthy that these represent only a selection of diverse definitions of innovation, each tailored to specific areas of study, subjects, or disciplines. However, it is crucial to emphasize definitions that facilitate an understanding of the driving forces and pertinent variables for measuring innovation within firms during the evaluation of an initial public offering (IPO).

For instance, in the context of knowledge management, there is a pronounced emphasis on the concept that ‘knowledge’ itself may constitute an innovation, thereby bearing significance in the assessment of innovation's impact on a firm's performance. According to Du Plessis (2007), innovation entails the creation of new knowledge and ideas with the goal of improving internal business processes, organizational structures, and the development of market-driven products and services. Innovation encompasses both radical and incremental forms.

This definition allows us to infer that, in a business context, 'innovation' pertains to activities and processes aimed at translating ideas into marketable products, consequently generating value for the originating company. In essence, innovation can be distilled as 'the successful realization of novel ideas.' However, it is paramount to focus on the transformation of ideas into 'market-driven products and services,' particularly concerning the required investments and the actual outcomes of this transformative process.

Innovation is unequivocally a cornerstone of competitive advantage within dynamic environments, exerting a substantial influence on the economic growth of nation-states.

The ability to innovate holds direct implications for competitiveness at the individual, corporate, regional, and national levels. The value generated by innovations typically manifests in novel approaches or products and processes that contribute to overall wealth. When considering a firm as a composite of resources, skills, and competencies, innovation serves as a catalyst for reshaping a firm's inherent capabilities, rendering it more adaptable and proficient in learning and leveraging new ideas. This heightened adaptability is of paramount importance in the face of shifting market dynamics. Consequently, innovation serves as a pivotal driver in enhancing the competitiveness of firms.

2.2 Measuring Innovation in Enterprises

Scholars in the context of capital markets have long recognized the pivotal role of innovation within a company's internal value chain. Enterprises, in their pursuit of advancing research and development (R&D) endeavors and introducing innovative goods and services, necessitate the acquisition of capital to enhance their market performance.

Pioneering research in this domain underscores the positive correlation between innovation and a firm's value (Griliches, 1981; Pakes and Griliches, 1985). Griliches (1981), for instance, investigated the impact of investment in innovation on corporate productivity by examining patent counts and R&D expenditures across a sample of US companies. His findings revealed that investments in innovation could yield long-term returns of up to 200%. However, recent studies have sought to shed light on the implications of innovation within the initial public offering (IPO) market, but they have yet to elucidate the specific contributions of innovation to IPO pricing and short-term performance.

Empirical evidence from the pertinent literature suggests that companies often experience heightened creative efforts during the period leading up to their IPOs (Bernstein, 2015). Furthermore, successful innovation often serves as a catalyst for private companies to transition into publicly traded entities (Pástor and Veronesi, 2009).

Advanced financial markets facilitate increased access to capital and reduced project assessment costs for businesses. Existing research has demonstrated that such markets foster innovation (Brown et al., 2009; Hsu et al., 2014). Nevertheless, determining how innovation ultimately affects the market value of firms remains a challenging task, primarily due to the inherent uncertainty associated with the outcomes of innovation investments. This uncertainty gives rise to information asymmetry issues and complicates the accurate estimation of the value generated by innovative initiatives.

Additionally, investments in research and development create an information gap for external investors. The evaluation of intangible assets like R&D, as opposed to tangible assets like factories and machinery, introduces information asymmetry issues due to the limitations of accounting evaluation methodologies (Aboody and Lev, 2000; Guo et al., 2006). Furthermore, agency theory posits that managers may allocate funds to R&D to enhance their own compensation (Jensen and Smith, 2000), thereby adding hidden costs to companies alongside potential future benefits. Consequently, despite serving as a reliable signal to the market, innovation capital investment has not fully resolved the anomalies associated with IPOs or corporate decisions to go public.

Contemporary research suggests that market investors should consider additional information related to innovation investment and R&D expenditure to effectively evaluate innovation capital and activities (Cohen et al., 2013; Hirshleifer et al., 2013). For instance, Chen and Xu (2015) distinguish between innovation input (i.e. resources, efforts, and investments directed towards generating novel ideas, concepts, or technologies within an organization or industry), and innovation output (i.e. outcomes and results that stem from the innovation process), suggesting that knowledge derived from these innovation assessments may have varying implications for investors. Innovation input tends to exhibit greater uncertainty compared to innovation output, and the disclosure of innovation input is discretionary, while the disclosure of innovation output, such as patents, is supported by legal documentation and thus considered more reliable. Consequently, these two dimensions of information have distinct effects on the IPO market (Zhou and Sadeghi, 2019).

The extant literature underscores the absence of a universally applicable methodology for assessing innovation performance. Metrics employed by one company

may not be transferable to another. Adopting pragmatic frameworks and employing a diverse set of measures is advisable for a comprehensive perspective on innovation performance measurement. Such measurement is crucial for two primary reasons: firstly, it provides feedback on a company's current level of innovativeness, and secondly, it initiates a systematic process of ongoing improvement. Without performance monitoring, the innovation process cannot be effectively managed, and improvements may occur sporadically.

It is worth noting that the majority of previous research on the significance of innovation for IPO market performance has been conducted in developed countries, notably the United States. However, studies examining stock markets in various countries indicate that IPO underpricing is a global phenomenon (Boulton et al., 2011), demanding a specific focus on its unique dynamics. For instance, the Chinese capital market exhibits significant levels of IPO underpricing, as evidenced by anomalous first-day returns in the Chinese A-share market from 1990 to 2016 (Zhou and Sadeghi, 2019).

Several authors have utilized information asymmetry theory to explore the phenomenon of IPO underpricing in the Chinese equity market. Mok and Hui (1998), for instance, highlighted the role of proxies for ex-ante uncertainty in shaping A-share IPO returns from 1990 to 1993. Meanwhile, findings reported by Chan et al. (2004) suggest that distinct regulatory settings in China have exacerbated information asymmetry, leading to increased levels of underpricing in the IPO process. Consequently, given the unique regulatory system in the Chinese IPO market, it is essential to provide an overview of the IPO system in this context to clarify its distinctions from mature financial systems.

Despite being the world's second-largest economy, China's economic landscape is still evolving and is characterized by distinct institutional and regulatory features that differ significantly from those of most developed nations. In a bid to foster an innovative economy, China has embarked on a policy path of boosting financial support and incentive programs for innovation capital. Research within emerging markets, such as China, faces greater complexity due to the diverse regulatory frameworks relative to mature financial systems. Notably, IPO regulations have witnessed substantial activity

over the past decade, necessitating an in-depth examination of major changes in IPO regulation to better comprehend the dynamics of the Chinese market.

2.3. IPO Theoretical Framework and Market Phenomena

An Initial Public Offering (IPO) marks the inaugural issuance of a company's equity shares to the general public, along with its listing on a stock exchange.

In the initial phase of IPO preparation, the company conducts a thorough self-assessment, considering factors such as financial performance, growth prospects, adherence to corporate governance principles, and regulatory compliance. To navigate the intricacies of the IPO process, the company assembles a team of advisors, including underwriting investment banks, legal counsel, and accounting firms. Subsequently, during the due diligence and disclosure stage, a comprehensive dataset is collected, and audited financial statements are meticulously prepared to formulate the IPO prospectus. This document serves as a comprehensive repository of information concerning the company's operational facets, financial standing, associated risks, and management team. Following this, the company proceeds to file the prospectus and requisite documentation with the pertinent regulatory bodies, such as the Securities and Exchange Commission (SEC) in the United States.

The subsequent step entails the determination of offering terms, encompassing critical aspects such as the share price and the offering's size. This determination relies on multiple variables, including market conditions, investor demand, and the company's valuation. Simultaneously, the company and its underwriters allocate shares to various categories of investors. A comprehensive marketing campaign and roadshow are executed to stimulate interest and garner investor support. Once this phase is successfully concluded, the final offering price is determined, and the shares become officially listed on a stock exchange, facilitating public trading.

Subsequent to the IPO, the company bears the responsibility of maintaining consistent communication with its shareholders and the broader public, thereby ensuring adherence to reporting obligations and regulatory mandates. The IPO process is characterized by its dynamic nature, susceptibility to diverse influences, and

conformity to jurisdiction-specific regulations, underscoring the indispensability of professional counsel and strict adherence to pertinent legal frameworks for the realization of a prosperous IPO.

Within the academic literature, numerous theories elucidate the rationale behind firms opting for the path of going public. Predominantly grounded in the efficient market theory, these theories converge on the objective of enhancing firm value as a primary impetus behind the decision to undertake an Initial Public Offering (IPO).

Firstly, IPOs are often pursued as a means to secure capital for investment initiatives, concurrently diminishing the firm's weighted average cost of capital (Modigliani and Miller, 1963; Scott, 1976). This becomes especially relevant when firms have exhausted or found other financing options inadequate (Myers, 1984).

Furthermore, going public affords insiders and venture capitalists the opportunity to divest their holdings and diversify their investment portfolios. Founding members may also convert a portion of their wealth into liquid assets at a later juncture (Ritter & Welch, 2002). Thirdly, the likelihood of future acquisitions significantly increases when a firm is publicly traded, and shares can be utilized as a form of "currency" in potential takeover scenarios (Brau & Fawcett, 2006). Fourthly, becoming a public entity engenders augmented trust and confidence among investors, analysts, clients, creditors, and suppliers, thereby bolstering reputation and credibility (Maksimovic & Pichler, 2001). Lastly, going public may serve as a strategic tool to diversify ownership structures (Chemmanur & Fulghieri, 1999) or fortify the firm's position within the product market, acting as a deterrent to potential new entrants (Jong, Huijgen, Marra, & Roosenboom, 2012).

2.3.1 Performance following the IPO and market anomalies

The pricing of an Initial Public Offering (IPO) is a complex process with several contributing factors. One significant complexity arises from the absence of a pre-IPO market price and the limited operational history of the company prior to going public (Sindelar et al., 1994). This information asymmetry can lead to underpricing, where the IPO is undervalued, resulting in missed opportunities to raise sufficient capital,

effectively "leaving money on the table." Conversely, if the investment bank sets an excessively high IPO price, investors may not receive adequate returns, potentially leading to challenges like investor withdrawal and a loss of trust in the underwriter for future transactions.

The market anomalies stemming from these complexities include high initial returns or the "underpricing" phenomenon, fluctuations in IPO market activity (hot and cold markets), and long-term performance. Given the thesis's focus on studying the short-term performance of IPOs in the technology sector within a developing market like China, the primary focus of the analysis will be on underpricing. As previously mentioned, underpricing is a distinctive feature of financial markets in developing countries like China and exhibits different patterns compared to mature economies.

2.3.2 IPO underpricing

Underpricing refers to the practice of offering a company's shares to the public at a price lower than their market value on the first day of trading. This phenomenon is commonly observed in IPOs and has several motivations and effects. One reason for underpricing is to incentivize investors. By setting the IPO price below the anticipated market value, investors are enticed with the potential for an immediate profit. This strategy helps generate demand and attract investors to participate in the IPO.

Underpricing also helps overcome information asymmetry. As companies transition from being privately held to publicly traded, there may be a lack of information available to the general public. Setting the IPO price lower can serve as a signal of confidence in the company's prospects, bridging the information gap and encouraging investor participation despite uncertainties.

Another benefit of underpricing is the ability to build a diverse investor base. Lower IPO prices attract a wider range of investors, including institutional and retail investors. This broadens the investor pool, increases liquidity in the secondary market, and potentially enhances long-term stock performance.

Positive media coverage often accompanies IPOs that experience initial price increases due to underpricing. This media attention generates buzz and raises the company's profile, further driving investor interest and potentially boosting the stock price. However, underpricing comes at a cost to the company conducting the IPO. By setting the IPO price lower than the market value, the company receives less capital from the shares sold than it would if the shares were priced closer to their true value.

It is worth noting that underpricing is not always intentional or predictable. Various factors, including market dynamics, investor sentiment, demand-supply imbalances, and the perceived value of the company, influence the extent of underpricing. Investors should carefully evaluate the underlying fundamentals and long-term prospects of the company rather than solely relying on the initial price performance when considering an IPO investment.

In literature (Ibbotson R.G., 1975; Ljungqvist, 2008) among the main reasons for underpricing is asymmetric information, which focuses on the different information available that characterizes the different subjects involved in the IPO process (mainly investors). In fact, it may happen that some investors have an advantage because they have better information than others that allows them to know the real value of the shares. As a result, they will only participate in very advantageous IPOs, therefore characterized by a high level of underpricing.

Still, underpricing is sometimes exploited by the issuer to achieve the success of the IPO. In fact, the latter could induce a high-value company to show its "true value" to then benefit from a consequent high interest of investors for that particular stock. According to the authors of this theory, (Faulhaber & Allen, 1989), on the contrary, a low-value company would not benefit from communicating a value of its shares too high because the market would shortly after denying this value. As a result, the issuer could take advantage of the underpricing for future transactions of the company that is currently listed, as investors would perceive less uncertainty.

However, there are many phenomena and theories surrounding the literature on underpricing, and most of them are based on the information asymmetry that characterizes all the actors of IPO operations.

Table 1 - Equally Weighted Average Initial Returns for Selected Countries

Country	Sample Size	Time Period	Avg. Initial Return (%)
Australia	2,377	1976-2021	20.5
Austria	106	1971-2018	6.2
Belgium	154	1984-2017	11.0
Brazil	310	1979-2019	29.6
Canada	811	1971-2021	6.8
China	4,983	1990-2022	162.2
Finland	244	1971-2021	14.5
France	904	1983-2021	9.4
Germany	840	1978-2020	21.8
Greece	373	1976-2013	50.8
India	3,202	1990-2020	84.0
Indonesia	697	1990-2020	56.0
Iran	279	1991-2004	22.4
Israel	348	1990-2006	13.8
Italy	413	1985-2018	13.1
Japan	4,065	1970-2022	49.0
Malaysia	571	1980-2019	50.3
Mexico	149	1987-2017	9.9
Netherlands	245	1983-2021	12.0
New Zealand	277	1979-2022	15.5
Nigeria	125	1989-2017	12.8
Norway	368	1984-2021	10.3
Philippines	173	1987-2018	17.3
Poland	359	1991-2022	12.4
Russia	64	1999-2013	3.3
Saudi Arabia	126	2003-2021	179.2
Singapore	722	1973-2021	24.7
South Africa	342	1980-2018	17.2
South Korea	2,312	1980-2022	52.0
Spain	204	1986-2021	9.5
Sweden	442	1980-2021	28.2
Switzerland	173	1983-2021	24.6
Thailand	785	1987-2021	39.8
Turkey	529	1990-2022	13.0
United Arab Emirates	529	2003-2021	186.4
United Kingdom	5,309	1959-2020	15.7
United States	13,757	1960-2022	17.5

2.3.3 Chinese IPO institutional characteristics

The Initial Public Offering (IPO) process in China operates under stringent oversight by the China Securities Regulatory Commission (CSRC). Since its establishment, the CSRC has implemented a series of amendments aimed at refining the mechanism for share issuance and mitigating the notably high first-day returns, aligning them more closely with those observed in developed nations.

In contrast to the norms prevalent in emerging or developed securities markets worldwide, such substantial and frequent regulatory adjustments are relatively infrequent. These regulatory modifications have exerted a notable influence on the operational characteristics of the securities market and the post-IPO performance. Despite these iterative adaptations in the Chinese issuance oversight system, the extent of underpricing in China remains markedly higher than that recorded in any other global jurisdiction. For instance, China sustained one of the highest average underpricing rates globally from 1990 to 2022, exceeding 160% (Ritter, 1994).

The introduction of the inquiry and allocation method by the CSRC in 2005 initially led to a reduction in the average annual IPO underpricing rate to 50%. However, this rate experienced subsequent fluctuations, peaking at 193% in 2007. The global financial crisis (GFC) and a decline in the A-share index contributed to a decrease in the underpricing rate to 115% in 2008. The CSRC responded by suspending IPOs from December 2008 to June 2009, prompted by the confluence of the GFC and the surge in IPO activity during that period. The CSRC also discontinued the practice of providing window indications of pricing during this eight-month hiatus. Subsequently, the introduction of a revamped IPO issuance system occurred, accompanied by the release of the "Guiding Opinions on Further Reforming and Improving the Issuance System of New Shares" (CSRC Announcement [2009] No. 13). A comprehensive overview of the three most recent and substantial IPO reforms, enacted in 2010, 2012, and 2013 respectively, is presented by Lu and Mehdi (2019).

2.3.4 Three major reforms of Chinese IPO in 2010, 2012 and 2013

Various factors can exert influence over the Initial Public Offering (IPO) landscape in China, including government-imposed regulatory frameworks (Cheung et al., 2009). Recent regulatory alterations in China are directed at enhancing the efficacy of the IPO process, aligning it more closely with established economies. Xu and Zhang (2015) documented nine instances where IPOs on the China A-share market were temporarily suspended in recent years and subsequently reinstated. Notably, two of these suspensions occurred within the authors' sample period, spanning from July 2009 to December 2016, with one of them marking the lengthiest suspension in the history of the Chinese stock market. The first suspension period encompasses October 2012 to January 2014, spanning fifteen months, while the second covers July 2015 to November 2015, lasting four months. During the sample duration, alterations were introduced not only in the IPO issuance system but also in the regulation of IPO offer market pricing, as discussed below.

In October 2010, the China Securities Regulatory Commission (CSRC) issued the "Guidelines on Extending Reform of New Issue System" (CSRC Announcement [2010] No. 26) and initiated the second phase of IPO system reform. Subsequently, with the progression of IPO system reform, a continuous decline in IPO underpricing rates was observed.

In 2012, the CSRC released a document titled "Guiding Opinions on Further Reforming the Issue System of New Shares" (CSRC Announcement [2012] No. 10). This reform primarily aimed at strengthening information disclosure, adjusting the scope of inquiry, and placement proportions, introducing stock issuance regulations, enhancing issuance regulation, combatting speculation, and intensifying penalties for misconduct. However, this reform did not achieve its stipulated objectives, as issues such as elevated underpricing rates, excessive fundraising, and performance deterioration persisted even after the 2012 reform. Moreover, due to the stock market downturn and extensive self-examination and verification of IPOs by the CSRC, Chinese IPOs were suspended following the last suspension of Zhejiang Shibao on November 2nd, 2012. This suspension extended for fifteen months, constituting the lengthiest period of suspension in A-share history.

On November 30th, 2013, the CSRC issued the "Opinions on Further Promoting the Reform of the Issuance System of New Shares" (CSRC Announcement [2013] No. 42), signifying the formal transition of IPOs from the approval-based system to the registration-based system. The evolutionary trajectory of the system can be viewed as the shift in market supervision from a "government-oriented" approach to a "market-oriented" one, albeit without discernible success in IPO reform. Remarkably, anomalous returns on the IPO's initial offering day persisted regardless of the prevailing issuance system. Nevertheless, up until January 2014, CSRC regulations constrained Chinese IPO first-day underpricing to 44%. This date also marked the conclusion of the fifteen-month suspension period and the commencement of a new era under the registration-based issuance system.

These regulatory measures are anticipated to ultimately encourage companies to engage in more transparent public disclosures, thereby fostering information sharing. The discrete yet substantial regulatory shifts offer a nearly ideal natural experiment for investigating the informational content of firms' innovation capabilities and how innovative information is integrated into asset pricing.

Additionally, the incorporation of industrial policy in the Chinese IPO market introduces a novel dimension for evaluating the effectiveness of macroeconomic policies. The findings from different time periods demonstrate that, prior to 2014, the Chinese IPO market was influenced by the macroeconomic environment and firms' innovation capabilities, which, in turn, impacted the implementation of industrial policies. Moreover, this research enhances our comprehension of the implications of information asymmetry theory in the context of IPO underpricing.

Therefore, a pertinent inquiry arises concerning the ongoing relevance of the findings and insights derived from prior research in light of governmental initiatives aimed at mitigating the prevalent underpricing phenomenon within the Chinese financial market. It is crucial to assess whether the conclusions and implications drawn from earlier studies hold true in the current practical context, marked by efforts to curb underpricing.

2.4 IPO in the High-tech Sector

Despite the extensive body of literature addressing Initial Public Offerings (IPOs) and their associated value drivers, there remains a notable scarcity of attention directed toward companies that have come to define capital markets in recent years, specifically high-technology firms.

These companies have garnered attention due to their perceived long-term potential, often commanding price-to-earnings ratios that appear extravagant in comparison to most other industries. Their prosperity has catalyzed economic growth, and the advent of digital computer systems and automation has wrought transformative changes in consumer and organizational behavior over the past 25 years. A burgeoning yet swiftly expanding cohort of enterprises, entrepreneurs, and innovators has been instrumental in driving this upheaval.

Various studies (Gupta and Lehmann, 2003; Reichheld and Shefter, 2000) have shown that, even if it leads to substantial annual deficits, a company's viability within the Internet sector hinges on adopting a customer-centric orientation and rapidly expanding its customer base. Prominent examples such as Google and Amazon operated at a loss during their early phases, ultimately maturing into highly profitable entities.

As industry growth rates began to decelerate, companies commenced consolidation efforts, with some, such as Amazon, Facebook, and Google, achieving market dominance and exerting considerable influence over their respective sectors. Consequently, the information technology (IT) industry has begun to resemble other economic domains, albeit with a more rapid pace of evolution and greater valuation magnitudes (Popper, 2017).

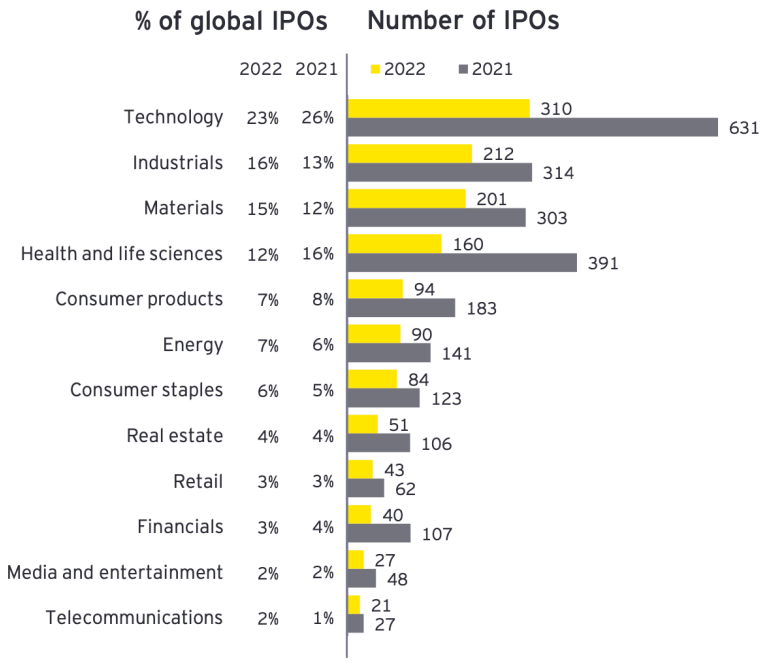
The technology sector notably dominated the global IPO landscape in 2022, notwithstanding enduring one of its most challenging years on public stock markets in over a decade. Despite this downturn in IPO activity, the tech sector boasted more public offerings in 2022 than any other sector.

This trend is not a recent phenomenon; the past has witnessed a prolonged series of IPOs involving companies that have operated or continue to operate within the high-technology sphere. On the New York Stock Exchange and NASDAQ from 1980 to 2022, a total of 3,311 IPOs and 9 direct listings belong to the category of tech stocks. This categorization excludes those with an offer price below $5.00 per share, unit offers, American Depositary Receipts (ADRs), closed-end funds, natural resource limited partnerships, and numerous other categories (Ritter, 1994).

The significance of the technology sector within the context of global financial markets underscores the need for an in-depth exploration of the short-term performance of these entities, particularly within a market characterized by high underpricing, such as China. Such an inquiry contributes significantly to the analysis of financial markets and rapidly growing economies.

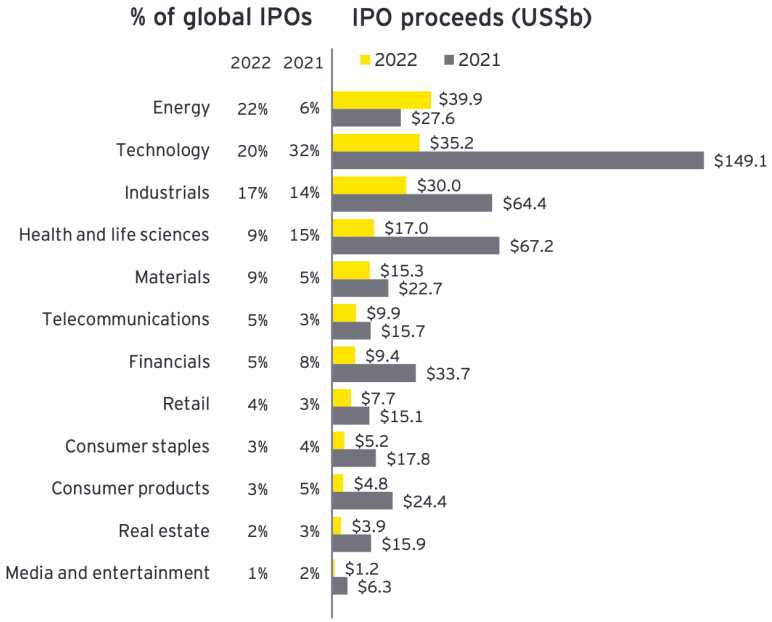
Furthermore, given the distinctive regulatory framework and institutional structure in China compared to developed markets, this examination can offer insights into unique factors and mechanisms at play. These insights, in turn, enrich the existing literature pertaining to market efficiency and financial valuation.

Table 2 - Number of IPOs Globally (by sector)



Source: EY Global IPO Trends 2022

Table 3 - IPO Proceeds (by sector)



Source: EY Global IPO Trends 2022

3. Hypotheses Development

3.1 Introduction

"Underpriced" shares are defined as shares subject to an IPO when the initial offer price is lower than the closing price on the first trading day, implying that the price at which the shares were initially placed on the stock market were offered with a lower value than the one determined by market dynamics. If this case occurs, then the management of the firm is believed to have "left money on the table" (Ritter, 1994) which investors will therefore be able to “pick up”; this identifies a portion of funds that could potentially have been raised by the company listed if the initial offer price had been more in line with the actual value of the firm.

As already highlighted in the literature review, it is possible to note that a large part of IPOs are on average underpriced. There are therefore several theoretical explanations that are used in the literature concerning underpricing, and can be collected in three main strands:

1) Information Asymmetry: an unequal distribution of information between different parties involved in the IPO process, such as company insiders (i.e. founders, executives, or early investors) and company outsiders (i.e. external investors, or the general public);

2) Institutionalism: the influence of various institutional forces, such as investment banks, underwriters, and regulatory bodies, that shape the pricing and allocation of shares during the IPO process;

3) Market Behavior: the actions and dynamics of market participants, including investors, traders, and speculators, that influence the pricing of IPO shares in the secondary market.

Focusing on short-term performance, which is the subject of this thesis, scholars attribute the underpricing of IPOs to the asymmetry of access to information concerning the company in question, since external investors naturally have limited information

about companies that interface with the primary market, making the process of evaluating the business and shares complex for these subjects. Other theories are being considered to explain underpricing, although the theory of information asymmetries remains the most consistent explanation for this (Ljungqvist, 2007).

3.2 Innovation Input and IPO Underpricing

The level of research and development spending (R&D spending) is often used by financial market scholars as a useful proxy to represent the innovative activity of the company aimed at increasing its output. However, as outlined earlier in the literature review, a higher level of R&D spending does not automatically translate into more innovative results.

In fact, the economic success of the company depends not only on how much it spends in search of innovations but also on the ability of management to transform innovation into profitable goods and services. Lev (2001) considers R&D as an element characterized by a high-risk profile and not transferable by the company and which can hardly be evaluated by the market.

As a result, investors interested in IPOs face valuation challenges in this area, as they cannot fully rely on balance sheets or economic prospects to get a complete view of the company's market value. All this is again based on the information asymmetry theory, in which the higher the level of R&D of companies, the greater the level of uncertainty at the business and financial level for investors. According to the research conducted in the Chinese market, companies that invest much in R&D may only sometimes be seen as highly creative for two reasons: initially, the company's pre-IPO R&D investment comprises capitalized and expensed R&D according to Chinese accounting standards. Put differently, the research and development investment listed on the company's balance sheet also includes the R&D expenses that are not capitalized throughout the company's operations (Xu et al., 2016). This operation creates asymmetric information and mispricing of the new share by preventing investors from accessing the critical investment information from the company's pre-IPO R&D investment in the balance sheet.

Second, a company's balance sheet or prospectus does not provide sufficient information to assess the effectiveness of its R&D investment spending. According to Jian Zhao (2008), the firm's management style, organizational structure, and procedure for determining valuation standards all determine how beneficial an R&D investment is factors that are challenging for an IPO investor to gauge. As a result, an organization's R&D expenditure has an unpredictable nature and may cause a significant informant shortage in the initial public offering market.

In light of the previously reviewed literature and asymmetric information theory, the following hypothesis was developed and put to the test in this study:

H_1: Greater R&D spending by firms will result in a more severe IPO underpricing.

3.2 Innovation Output and IPO Underpricing

According to Kelm et al. (1995), technological innovation is an intricate process that goes through several stages, such as project starting, development, commercialization, patent acquisition, launching a product, etc. Therefore, innovation comes from R&D input rather than output. Businesses that have more innovation skills are better equipped to adjust to shifts in consumer demand, deploy internal resources effectively, produce new knowledge and technology, and hold a higher number of patents and technical knowledge. The two most significant technologically intangible assets owned by the companies are their patents and technical confidentiality. They can significantly lower the internal uncertainty around R&D efforts, as they are the direct result and outcome of R&D (Griliches, 1990; Lev, 2001).

The knowledge asymmetry between creative enterprises and investors exacerbates as a result of the prevalent practice of patenting. Investors are unable to accurately assess a company's capacity for innovation when it gets an IPO. The market, therefore, encourages businesses to reveal further details about their innovation endeavors. It is not because businesses withhold pertinent information from the public that makes assessing R&D spending difficult (Lev, 2001). Innovative businesses may reduce information asymmetry and increase information transparency by voluntarily disclosing information. According to Guo et al. (2005), the majority of biotechnology

companies in the United States choose to increase the openness of their information by disclosing R&D data when they go public. This immediately benefits businesses by lowering the cost of capital raising and increasing the market value of their shares. Therefore, market players will be more likely to notice creative enterprises that willingly share more R&D information (Jones, 2007).

The benefits of sharing innovation information with issuers include lowering the cost of financing, reducing uncertainty and information asymmetry in R&D, and sending favorable signals to the market, which can aid businesses in becoming public. As a result, the perception of an issuer's capacity for innovation increases with the number of patents they have. Furthermore, by providing the market with favorable signals, the information revealed in prospectuses might lessen the extent of IPO underpricing.

In light of the previous conversation, we go into further depth here on the connections between patents and IPO underpricing. Numerous studies in the field of innovative economics demonstrate that patents that capture advancements in technology significantly increase the value of businesses (Hall et al., 2005). According to Heeley et al. (2007), creative activities can lessen information asymmetry during an initial public offering (IPO) when the relationship between a firm's innovative operations and value generation is transparent.

Investors can utilize implicit information from patents, a non-financial information, to determine the market worth of research and development (R&D) projects, according to research by Hall et al. (2005). Approximately 99.5% of Chinese companies revealed their patent information in their IPO prospectuses between 2003 and 2014. Furthermore, the majority of the time, specifics on the patent number, categories of patents, and names of the patent holders were made public (Zhang and Zhang, 2016). Investors therefore believe that companies with a higher number of issued patents have better quality research and development and are more likely to perform well (Lev, 2001).

Thus, the following is the hypothesis on the connection between patent disclosure and the degree of IPO underpricing:

H_2: A greater number of patents prior IPO will result in a lower IPO underpricing.

4. Data and Methodology

4.1 Dataset and Sample Selection

This thesis aims to investigate the correlation between a company's innovative activities and its short-term performance following an Initial Public Offering (IPO) within the time frame spanning from 2014 to 2022. The choice of this specific period stems from a well-considered rationale. The lower bound of the selected timeframe, namely 2014, was deliberately chosen to exclude data from two pivotal junctures in the technology sector. Firstly, it excludes the early 2000s, a period marked by a substantial decline in IPO activity within the tech sector, primarily attributed to the crisis that afflicted this industry during that time. Secondly, with regard to the Chinese market context, the years preceding 2014 witnessed a series of significant stock market reforms concerning IPOs. These reforms introduced elements that could potentially introduce confounding variables and adversely affect the robustness and interpretability of the study's findings. Conversely, the upper-bound of 2022 was chosen to encompass the most up-to-date information regarding IPO performance, ensuring that the analysis incorporates recent developments in this dynamic market.

For a dataset to be appropriately composed, many processes are required. First, a list of all international high-tech companies that had an IPO between 2014 and 2022 has to be compiled. The Refinitiv Business Classification, a market-based classification scheme similar to GICS and ICB systems, has been used to define the industries of interest for this thesis. In particular the industries selected were: Integrated Hardware & Software, Household Electronics, Phones & Handheld Devices, Computer Hardware, Office Equipment, Electronic Equipment & Parts, Communications & Networking, Semiconductor Equipment & Testing, Semiconductors, Online Services, Software, IT Services & Consulting, Miscellaneous Fintech Infrastructure, Blockchain & Cryptocurrency, Crowd Collaboration, Financial Technology (Fintech). Refinitiv Eikon Datastream, Bureau Van Dijk’s Orbis (former Zephyr), Orbis Intellectual Property, and Bloomberg databases were used to filter the IPO useful to form such dataset. Each of these databases allows to choose the target industry to be examined and were used to extract the data for this study. This sample includes businesses that

offer financial services, B2B e-commerce, IT consulting, software development, and development of micropressors. As a consequence, the sample takes into account a variety of high-tech business realities in order to produce findings that may be generalized to the whole industry.

Following the identification of the specific industry and companies for the analysis, the next step involved the extraction of essential data required for conducting the regression analysis on underpricing. A significant portion of the required data was sourced from Refinitiv Eikon Datastream, encompassing key variables such as the proceeds amount, the presence of venture capital, stock prices, offer price, total assets, and details regarding bookrunners or co-managers. Subsequently, data extraction was facilitated by Bureau Van Dijk's Orbis database, which provided information pertaining to the IPO date, the founding date of the company, and the number of patents held. Additionally, crucial data elements, such as R&D Intensity and IPO trading volume, were sourced from Bloomberg databases.

In cases where specific pieces of information were not readily accessible through these primary databases, alternative data sources like Yahoo! Finance were utilized to complete the dataset. However, it's important to note that if any requisite information proved unattainable through these means, the respective company was excluded from the analysis to ensure data integrity and consistency throughout the study.

The final sample consists of 274 Chinese IPOs of high-tech companies, in Shanghai and Shenzhen stock exchanges, distributed among the years as shown in *Table 4* below.

Table 4 - IPO Distribution per Year

IPO Year	Number of IPOs
2014	16
2015	23
2016	38
2017	62
2018	12

IPO Year	Number of IPOs
2019	10
2020	32
2021	32
2022	49
Total	274

Source: Refinitiv Eikon

4.2 Regression Model

The Multiple Linear Regression approach is the one utilized to test the hypothesis, where a number of independent variables are used in this statistical procedure in order to predict the result of the dependent variable.

The equation for Multiple Linear Regression is as follows:

$$\gamma_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_p x_{ip} + \epsilon$$

- $i = n$, represents the number of observations;
- γ_i represents the dependent or predicted variable;
- β_0 represents the y-intercept;
- β_1 and β_2 represent the regression coefficients. They indicate the change in γ_i relative to a one-unit change in x_{i1} and x_{i2};
- β_p is the slope coefficient for each independent or control variable;
- ϵ represents the random error resulting from the model.

As stated in the hypothesis, the regression approach was used in the current study to assess the relationship between the dependent and independent variables.

The equation considered to examine the association between the IPO underpricing phenomenon and the innovation degree of a company is as follows, adapting the regression model to the goals of this study:

$$UP = \beta_0 + \beta_1 * RDI + \beta_2 * PAT + \beta_3 * control\ variables + \epsilon$$

Where:

- UP is the dependent variable;
- RDI (R&D Intensity), and PAT (Patents) are the independent variables;
- $control\ variables$ represents all the control variables chosen to perform the analysis

4.3 Variables Explanation

4.3.1 Dependent variables

a) Underpricing

Analyzing the short-term performance by determining the degree of underpricing is the first stage in the process. The following equation for the first-day return of the stock may be used to calculate the degree of IPO underpricing in accordance with prior research and the conventional method:

$$Underpricing = \frac{(First\ day\ closing\ price - Offer\ Price)}{Offer\ Price}$$

or

$$UP_{i1} = IR_{i1} = \frac{P_{i1,t} - P_{i0}}{P_{i0}} \times 100\% = \left(\left(\frac{P_{i1,t}}{Pi0}\right) - 1\right) \times 100\%$$

Where the closing price of the stock "*i*" is denoted as "$P_{i1,t}$" at the end of the first day of issue, and "P_{i0}" is the offering price.

4.3.2 Independent variables

a) Innovation input (R&D Intensity)

According to Yiu et al., (2020) R&D Investments can be measured by their R&D intensity, that is, the ratio of R&D expenses to sales. It was possible to retrieve such information through Bloomberg database, selecting R&D Intensity at the IPO year.

b) Innovation output (Patents)

In the course of a company's production, patents constitute an output of innovation capital (Chen and Xu, 2015). Therefore, the number of patent applications and acquired patents was used. The logarithm of patent numbers is then used in the analysis as a metric for measuring innovation output.

4.3.3 Control variables

a) Total Proceeds

Li (2006) asserts that the size of the offering is likewise negatively associated with the IPO underpricing rate. Thus, to account for the IPO underpricing, we use the natural logarithm of total proceeds (total issue volume times issue price).

b) Size (Total assets)

According to earlier studies (Barth and Kasznik, 1999), larger enterprises should have less information asymmetry. In order to account for the size impact, we will utilize the natural logarithm of total assets before offering.

c) Volume

According to Lowry (2003), IPO trading volume has a favorable effect on the firm's need for capital and the mood of investors. Firms with larger trading volumes, according to Baker and Wurgler (2007), suggest that investors are more positive about the new concerns and are more inclined to trade in the market. As a result, the natural logarithm of IPO trading volume has been used to account for the influence of investor mood.

d) Age of the firm (Age)

The age of the business affects its organizational results, particularly its performance, as acknowledged by the authors of previous research (Filatotchev and Bishop, 2002). The age of a firm has been measured from the date of its establishment to the date of its IPO.

e) Underwriter reputation

According to earlier studies (Carter and Manaster, 1990; Higgins and Gulati, 2000), an underwriter's reputation significantly impacts initial public offerings (IPOs) underpricing. The published data primarily show that companies with more prestigious underwriters for their first public offerings tend to have lower IPO underpricing rates. In this model, a dummy variable is used to quantify the impact of underwriter reputation on the IPO underpricing rate, by this research. Firms will be classified as 1 if they employ at least one of the A rated underwriters from the China Securities Regulatory Commission.

On *Table 5* below, the complete list of underwriters with the highest reputation according to the rating given by the China Securities Regulatory Commission.

Table 5 - List of Prestigious Underwriters

Underwriter	Number of IPO in the sample
CICC	12
China Galaxy Securities	3
China Merchants Securities	16
CITIC Securities	24
CSC Financial	0
Essence Securities	4
Everbright Securities	7
GF Securities	8
Guosen Securities	24
Guotai Junan	5
Huatai Securities	14
Industrial Securities	7
Orient Securities	7
Ping An Securities	2
Shenwan Hongyuan	7

Source: China Securities Regulatory Commission Annual Report 2020

f) Venture Capital

According to Gompers (1996), investment firms' IPO underpricing rates will be higher the younger the venture-capital firms are. According to more recent study by Chahine et al. (2012), venture capital businesses with a variety of attributes could

anticipate to see greater rates of IPO underpricing. Last but not least, Zhang (2016) discovered that the venture capital-backed listed companies had a statistically insignificantly low percentage of IPO underpricing. The argument over whether venture capital and IPO underpricing are related is still up for grabs, though. A dummy variable, representing venture capital presence at IPO is consequently added to the model.

All the variables used in the present study are summarized and explained in the *Table 6* below.

Table 6 - Variables Definition

Variable	Definition	Data source
IPO underpricing (UP)	Natural logarithm of first-day return.	Bloomberg
Innovation input (RDI)	Natural logarithm of R&D intensity as ratio of R&D expenses to sales at IPO year.	Bloomberg
Innovation output (PAT)	Natural logarithm of Number of patent applications and acquired patents.	Orbis Intellectual Property
Total proceeds (PROC)	Natural logarithm of total proceeds as total issue volume times issue price.	Refinitiv Eikon
Size (SIZE)	Natural logarithm of total assets before offering.	Refinitiv Eikon
Trading volume (VOL)	Natural logarithm of IPO trading volume.	Refinitiv Eikon
Firm age (AGE)	Number of years between the founding year and listing year.	Refinitiv Eikon, Orbis
Underwriter reputation (UW)	Dummy variable, which denotes 1 for ‘prestigious underwriter’ and 0 for ‘otherwise’.	Refinitiv Eikon
Venture capital (VC)	Dummy variable, which denotes 1 for 'venture capital present at IPO' and 0 for 'otherwise'.	Refinitiv Eikon

4.4 Applications

Below are all the descriptive statistics tables and correlation matrices for the four samples on which the analysis was carried out, so as to be able to evaluate any differences in the regression results.

The main dataset was then divided into three separate categories according to the Total Assets of each company, using the 25th and 75th percentile values as the dividing thresholds. This categorization was undertaken with the specific aim of investigating whether distinct patterns emerged, in contrast to the entire sample, in the connections between the selected variables depending on the company's size.

4.4.1 Descriptive statistics main sample

The main sample has been examined to determine the descriptive statistics for the dependent, independent, and control variables prior to doing the multiple regression analysis.

The major findings of the descriptive statistical analysis performed on the main sample are shown in *Table 7* below.

Table 7 - Descriptive Statistics (Main Sample)

Variable	Observation	Mean	Min	Max	Q1	Median	Q3	Std. Dev
UP[1]	274	0.28	-0.06	1.99	0.20	0.23	0.27	0.27
RDI[1]	274	0.08	0.01	0.32	0.04	0.06	0.11	0.06
PAT[1]	274	4.32	0	7.58	3.56	4.54	5.23	1.60
PROC[1]	274	11.23	9.79	13.21	10.72	11.19	11.74	0.70
SIZE[1]	274	11.72	10.22	14.32	11.20	11.64	12.13	0.75
VOL[1]	274	12.49	8.58	17.90	10	11.39	16.15	2.96
AGE	274	14.73	3	29	10	14	18	5.75
UW	274	0.49	0	1	0	0	1	0.50
VC	274	0.59	0	1	0	1	1	0.49

[1] *Logarithm*

Additionally, *Table 8* displays the results of the correlation analysis that represent the study's dependent, independent, and control variables.

Table 8 - Correlation Matrix (Main Sample)

	UP	RDI	PAT	PROC	SIZE	VOL	AGE	UW	VC
UP	1.000								
RDI	0.074	1.000							
PAT	-0.196	-0.141	1.000						
PROC	-0.278	-0.055	0.161	1.000					
SIZE	0.008	-0.220	0.270	0.629	1.000				
VOL	0.236	0.006	-0.049	0.570	0.303	1.000			
AGE	0.081	-0.060	0.052	0.027	0.090	0.121	1.000		
UW	-0.069	0.024	0.096	0.080	0.161	-0.085	-0.120	1.000	
VC	-0.092	-0.008	0.180	-0.104	0.018	-0.223	-0.066	0.030	1.000

The calculated mean IPO underpricing for the selected industry and sample within the timeframe of 2014-2022 amounts to 0.2849. This figure aligns closely with the mean value of 0.2760 reported in a study by Lin and Tian (2012), which encompassed data from 34 countries. Furthermore, when considering the innovation capital, the average count of innovation outputs, measured in terms of patents, is 227.

It is worth noting that Foxconn Industrial Internet Co Ltd. (601138) stands out with a notably higher count of 5350 patents, likely attributed to its distinct position within the selected industry. This count surpasses the averages found in other studies, such as the research conducted by L.J. Zhou and M. Sadeghi (2018), where the mean patent count was 70. This variance could be attributed to the specific characteristics of the industry under investigation in this study, characterized by its high degree of innovation and, consequently, a greater propensity to generate patents for the protection and commercialization of novel technologies.

4.4.2 Descriptive statistics large-sized companies subsample

The first subsample (i.e. *Large companies*) has been examined to determine the descriptive statistics for the dependent, independent, and control variables prior to doing the multiple regression analysis.

The major findings of the descriptive statistical analysis performed on the first subsample are shown in *Table 9* below.

Table 9 - Descriptive Statistics (Large Companies)

Variable	Observation	Mean	Min	Max	Q1	Median	Q3	Std. Dev
UP[1]	69	0.28	-0.07	1.62	0.20	0.23	0.27	0.27
RDI[1]	69	0.07	0.00	0.48	0.04	0.05	0.08	0.07
PAT[1]	69	4.87	0	8.59	4.01	5.06	5.69	1.61
PROC[1]	69	11.86	10.66	13.21	11.31	11.86	12.23	0.78
SIZE[1]	69	12.77	12.13	16.87	12.33	12.56	12.92	0.75
VOL[1]	69	13.53	9.58	17.92	10.59	12.36	16.93	2.98
AGE	69	14.99	3	33	9	16	19	6.38
UW	69	0.62	0	1	0	1	1	0.49
VC	69	0.59	0	1	0	1	1	0.49

[1] *Logarithm*

Additionally, *Table 10* displays the results of the correlation analysis that represent the study's dependent, independent, and control variables.

Table 10 - Correlation Matrix (Large Companies)

	UP	RDI	PAT	PROC	SIZE	VOL	AGE	UW	VC
UP	1.000								
RDI	0.081	1.000							
PAT	-0.366	0.128	1.000						
PROC	-0.318	0.018	0.389	1.000					
SIZE	-0.134	-0.145	0.280	0.685	1.000				
VOL	0.203	0.016	-0.047	0.383	0.074	1.000			
AGE	0.103	-0.010	-0.000	-0.085	0.059	0.017	1.000		
UW	-0.172	0.028	0.101	0.028	0.017	-0.192	-0.200	1.000	
VC	0.046	0.094	0.153	0.034	0.113	-0.215	-0.170	0.027	1.000

The calculated mean IPO underpricing for the selected industry and subsample within the timeframe of 2014-2022 amounts to 0.2807. Furthermore, when considering the innovation capital, the average count of innovation outputs, measured in terms of patents, is 375.

4.4.3 Descriptive statistics medium-sized companies subsample

The second subsample (i.e. *Medium companies*) has been examined to determine the descriptive statistics for the dependent, independent, and control variables prior to doing the multiple regression analysis.

The major findings of the descriptive statistical analysis performed on the second subsample are shown in *Table 11* below.

Table 11 - Descriptive Statistics (Medium Companies)

Variable	Observation	Mean	Min	Max	Q1	Median	Q3	Std. Dev
UP[1]	136	0.31	-0.05	2.00	0.19	0.23	0.29	0.32
RDI[1]	136	0.08	0.02	0.26	0.04	0.06	0.11	0.06
PAT[1]	136	4.40	0.69	7.56	3.64	4.49	5.24	1.47
PROC[1]	136	11.19	9.79	12.44	10.78	11.21	11.60	0.58
SIZE[1]	136	11.64	11.22	12.11	11.46	11.64	11.82	0.24
VOL[1]	136	12.73	9.12	17.41	10.06	11.95	16.20	2.87
AGE	136	14.95	4	29	11	14.5	18.5	5.53
UW	136	0.48	0	1	0	0	1	0.50
VC	136	0.58	0	1	0	1	1	0.50

[1] *Logarithm*

Additionally, *Table 12* displays the results of the correlation analysis that represent the study's dependent, independent, and control variables.

Table 12 - Correlation Matrix (Medium Companies)

	UP	RDI	PAT	PROC	SIZE	VOL	AGE	UW	VC
UP	1.000								
RDI	0.154	1.000							
PAT	-0.131	0.069	1.000						
PROC	-0.405	0.006	0.044	1.000					
SIZE	0.015	-0.102	0.117	0.220	1.000				
VOL	0.302	0.039	0.005	0.467	0.057	1.000			
AGE	0.068	-0.030	-0.076	0.026	-0.109	0.204	1.000		
UW	-0.079	0.054	0.066	-0.040	0.041	-0.154	-0.157	1.000	
VC	-0.171	-0.088	0.135	-0.186	0.009	-0.319	-0.024	-0.082	1.000

The calculated mean IPO underpricing for the selected industry and subsample within the timeframe of 2014-2022 amounts to 0.3054. Furthermore, when considering

the innovation capital, the average count of innovation outputs, measured in terms of patents, is 220.

4.4.4 Descriptive statistics small-sized companies subsample

The third subsample (i.e. *Small companies*) has been examined to determine the descriptive statistics for the dependent, independent, and control variables prior to doing the multiple regression analysis.

The major findings of the descriptive statistical analysis performed on the third subsample are shown in *Table 13* below.

Table 13 - Descriptive Statistics (Small Companies)

Variable	Observation	Mean	Min	Max	Q1	Median	Q3	Std. Dev
UP[1]	69	0.25	-0.06	0.64	0.20	0.23	0.26	0.09
RDI[1]	69	0.10	0.01	0.33	0.06	0.09	0.13	0.07
PAT[1]	69	3.64	0	6.80	2.71	4.01	4.81	1.66
PROC[1]	69	10.72	9.77	12.39	10.35	10.60	11.00	0.50
SIZE[1]	69	10.87	10.18	11.20	10.78	10.92	11.09	0.26
VOL[1]	69	10.95	8.01	16.52	9.31	9.98	11.07	2.52
AGE	69	14.08	2	28	10	13	17	5.72
UW	69	0.39	0	1	0	0	1	0.49
VC	69	0.61	0	1	0	1	1	0.49

[1] *Logarithm*

Additionally, *Table 14* displays the results of the correlation analysis that represent the study's dependent, independent, and control variables.

Table 14 - Correlation Matrix (Small Companies)

	UP	RDI	PAT	PROC	SIZE	VOL	AGE	UW	VC
UP	1.000								
RDI	-0.214	1.000							
PAT	-0.041	0.021	1.000						
PROC	-0.227	0.268	0.042	1.000					
SIZE	0.236	-0.165	0.112	0.191	1.000				
VOL	-0.137	0.282	-0.009	0.770	0.228	1.000			
AGE	0.106	-0.119	0.134	-0.020	0.324	-0.002	1.000		
UW	0.182	0.105	-0.124	0.019	0.176	-0.063	0.014	1.000	
VC	0.022	0.043	0.024	-0.131	0.096	-0.078	-0.014	0.156	1.000

The calculated mean IPO underpricing for the selected industry and subsample within the timeframe of 2014-2022 amounts to 0.2497. Furthermore, when considering the innovation capital, the average count of innovation outputs, measured in terms of patents, is 95.

5. Results and Analysis

Examining the outcomes of the models described in Chapter 4 is the focus of the chapter that follows. Such a section will go more into the importance and consistency of the models used on the analysis' primary sample and consequent subsamples.

5.1 Results

It has been determined how various factors used as proxies of innovation in business (R&D Intensity and number of patents), impact the IPO underpricing of the chosen sample of companies in the Chinese market through the study of the variables to test the research hypothesis. All the data inputs from all the companies and variables the 274 observations total for this study.

The outcome of the regression analysis for the entire sample is presented in *Column 1* of *Table 15*, providing a comprehensive overview of the relationship between the chosen dependent and independent variables under investigation. As previously illustrated in *Table 8* within the preceding chapter, it is possible to assess the correlation between these variables. Specifically, a positive correlation is evident between IPO underpricing and R&D Intensity (0.074), while a negative correlation is observed between IPO underpricing and the number of patents (-0.196). These correlations are reaffirmed in the subsequent regression analysis, with estimated coefficients of 0.446 and -0.021, respectively, both attaining statistical significance at a 5% level. In essence, these findings imply that as R&D Intensity increases, the company is more likely to experience greater IPO underpricing, whereas a higher number of patents within the company's portfolio tends to mitigate the extent of IPO underpricing it encounters.

Table 15 - Regression Results on Main Sample and Subsamples

	UP (*Column 1*) Main sample	UP (*Column 2*) Large companies	UP (*Column 3*) Medium companies	UP (*Column 4*) Small companies
RDI	0.446 **	0.575	0.891*	-0.181
	(2.03)	(1.39)	(2.52)	(-1.03)
PAT	-0.021 **	-0.039 **	-0.026 *	-0.001
	(-2.47)	(-2.00)	(-1.93)	(-0.23)
PROC	-0.322 ***	-0.210 ***	-0.412 ***	-0.057 *
	(-11.87)	(-3.47)	(-10.52)	(-1.73)
SIZE	0.151 ***	0.115 **	0.228 ***	0.075
	(6.54)	(2.08)	(2.72)	(1.65)
VOL	0.052 ***	0.038 ***	0.068 ***	0.004
	(9.53)	(3.35)	(8.20)	(0.55)
AGE	0.000	0.002	-0.002	0.000
	(0.13)	(0.37)	(-0.47)	(0.09)
UW	-0.005	-0.031	-0.023	0.031
	(-0.20)	(-0.51)	(-0.57)	(1.39)
VC	-0.018	0.081	-0.059	-0.010
	(-0.65)	(1.36)	(-1.38)	(-0.45)
_cons	1.552 ***	0.889 *	1.517	0.013
	(6.40)	(1.73)	(1.55)	(0.02)
Obs.	274	69	136	69
Adj. R^2	0.392	0.270	0.510	0.064

T-values are reported in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

5.2 Discussion and Further Analysis

The analysis conducted thus far has yielded robust and positive results for the model and the underlying hypothesis. A notable and statistically significant correlation has been established between the dependent variable and the independent variables, namely R&D intensity (RDI) and the number of patents (PAT). Similarly, several control variables, including PROC, SIZE (representing Total Assets at the IPO year), and VOL, have exhibited significant correlations, reinforcing the model's reliability.

To gain deeper insights into the influence of a firm's innovation on short-term post-IPO performance, the sample has been stratified based on company size. This stratification leverages the variable SIZE, which denotes Total Assets at the IPO year, and involves dividing the companies into three distinct categories: Large, Medium, and Small companies, each representing different percentiles (i.e. upper 75th percentile for *Large companies*, and lower 25th percentile for *Small companies*) within the total sample. This categorization enables a comprehensive reevaluation of the regression model, shedding light on whether a company's size exerts a distinct impact on the analytical outcomes.

5.2.1 Main sample

R&D Intensity

The analysis reveals a distinct relationship between the innovation input, particularly the investment in Research and Development (R&D), and the phenomenon of IPO underpricing, consistent with the proposed hypothesis H_1. Notably, this relationship exhibits statistical significance at the 5% level, emphasizing its robustness. In practical terms, this finding implies that companies that allocate a higher proportion of their resources to R&D activities prior to their IPO tend to experience a more pronounced degree of underpricing when going public. This result may be attributed to several factors, including the anticipation of greater future costs associated with R&D efforts or the perception of higher risk among investors due to increased innovation activities. It underscores the intricate interplay between innovation inputs, such as R&D investments, and the pricing dynamics of IPOs, suggesting that a company's strategic choices in this regard can significantly influence its IPO underpricing outcomes.

Patents

Regarding the main sample analyzed in this study, the findings indicate a statistically significant negative correlation between the innovation outcome, specifically measured by the number of patents held by companies, and the level of IPO underpricing. This outcome aligns with the previously posited hypothesis H_2, providing empirical support for the notion that firms with a greater number of patents in their

portfolio prior to their initial public offering (IPO) tend to experience a reduced degree of underpricing when going public. In other words, the data suggests that companies with a stronger intellectual property foundation, as represented by their patent holdings, are more likely to achieve IPOs with lower levels of underpricing, highlighting the potential value attributed by investors to intellectual property and innovation in the IPO valuation process.

Moreover, in *Table 8*, there is a negative association between R&D and the number of patents (-0.141). The number of patents, which is regarded as the innovation output in a free market economy, is theoretically related to the R&D intensity, which is an innovation input. The number of patents is a productivity indicator and a source of knowledge for businesses to better effectively allocate R&D resources. As a result, this study's negative correlation trend in the relationship between patent issuance and R&D suggest that businesses are now obtaining fewer patents from their more recent R&D investments due to a decline in the "effectiveness" or productivity of their investment in innovation.

Total Proceeds

Within the main sample model, the variable PROC exhibits a notable coefficient of -0.322, accompanied by a standard error of 0.027. The corresponding t-statistic, calculated at -11.87, and a p-value less than 0.001 emphasize the statistical significance of this control variable. This negative β coefficient signifies a discernible inverse correlation between the dependent variable, IPO underpricing, and the control variable Total Proceeds (PROC). Essentially, this suggests that as the number of Total Proceeds decreases, IPO underpricing tends to increase. This observation aligns with the concept of "leaving money on the table," a phenomenon commonly associated with initial public offerings characterized by substantial underpricing. In such cases, it implies that the company could have potentially garnered more capital during the IPO if the offer price had been more closely aligned with the actual value of the firm.

Firm Size (Total Asset)

The analysis conducted on the main sample yields a significant finding regarding firm size, denoted as SIZE. This variable exhibits strong statistical significance, as evidenced by a substantial positive coefficient of 0.151. This coefficient signifies a notable effect: larger companies tend to be more susceptible to underpricing during their initial public offerings (IPOs). Furthermore, this conclusion is supported by a standard error of 0.023, which helps establish the reliability of the coefficient estimate. The t-statistic, calculated at 6.54, underscores the robust statistical significance of the relationship between firm size and underpricing. Additionally, the p-value, registering as less than 0.001, further accentuates the strength of this control variable within the model. This collective evidence highlights that larger companies experience a higher degree of underpricing during their IPOs, and this relationship holds true with considerable statistical confidence.

Trading Volume

The variable VOL, representing trading volume, emerges as another control variable of notable statistical significance within the model. In this context, trading volume serves as a proxy for gauging investor interest in the IPO. The analysis reveals that trading volume exhibits a positive coefficient of 0.052, underpinned by a remarkably low standard error of 0.005. The associated t-statistic, computed at 9.53, reinforces the robust statistical significance of this relationship. Moreover, the p-value, registering as less than 0.001, further underscores the statistical strength of the correlation between trading volume and underpricing. These findings are consistent with established literature, as they align with the widely accepted notion that heightened investor interest in an IPO tends to drive up prices during the initial trading day. Consequently, this heightened investor interest contributes to a greater degree of underpricing, a trend substantiated by the empirical evidence in this analysis.

Age

The control variable representing the age of the firm did not yield statistically significant results, both in the main sample and across the various subsamples proposed

for the analysis. In the main sample, the coefficient associated with firm age was negligible, registering at 0.000. The standard error for this coefficient stood at 0.002, and the calculated t-statistic was a mere 0.13. These outcomes collectively indicate that the age of the firm did not exert a discernible impact on IPO underpricing within the chosen sample. In other words, the age of the firm did not play a significant role in explaining variations in underpricing across the observed IPOs. This finding underscore that, in this particular sample and context, the age of the firms did not significantly influence the extent of underpricing experienced during their respective IPOs.

Underwriter Reputation

The control variable related to underwriter reputation did not yield statistically significant results in any of the samples or subsamples examined within this thesis. In the main sample, specifically, it exhibited a negative coefficient of -0.018 in relation to the dependent variable, IPO underpricing. The standard error associated with this coefficient was measured at 0.026, and the calculated t-statistic stood at -0.20. These results collectively demonstrate that underwriter reputation did not exert a significant influence on explaining variations in IPO underpricing across the dataset. In essence, the reputation of the underwriter was not found to be a statistically significant factor affecting the extent of underpricing observed in the IPOs examined within this study.

Venture Capital presence

In the specific sample examined in this analysis, the presence of a Venture Capital (VC) fund that had supported the company did not yield statistically significant results in terms of its impact on the level of IPO underpricing across the various models computed. In the main sample, for instance, the coefficient associated with this variable was calculated to be -0.018, while the standard error for this coefficient was measured at 0.027. The resulting t-statistic for the VC presence variable was found to be -0.65. These statistical indicators collectively indicate that the presence of a Venture Capital fund backing the company did not exert a statistically significant influence on explaining the variations in IPO underpricing observed in the dataset. In other words, the involvement of Venture Capital in a company's pre-IPO activities did not appear to

be a significant factor affecting the extent of underpricing in the IPOs examined in this study.

5.2.1 Division by size

In order to conduct a more comprehensive examination of the influence of innovation within high-tech enterprises on their immediate performance, specifically IPO underpricing, a refined analysis was undertaken. The primary dataset was stratified into three distinct categories based on the Total Assets of each company, employing the 25th and 75th percentile values as the demarcation points. This segmentation was executed with the precise objective of exploring whether discernible variations existed, in comparison to the overall sample, in the relationships among the designated variables contingent upon the size of the firms. In essence, the aim was to investigate whether there were disparities in the "efficiency" of Research and Development (R&D) investments and their repercussions on underpricing, contingent upon the size of the firms under scrutiny. This analytical approach allowed for a more nuanced understanding of how innovation dynamics interact with firm size and subsequently impact IPO underpricing.

Large companies

The initial subset, prominently presented in *Column 2* of *Table 15*, encompasses a total of 69 companies, each of which signifies the upper echelon, representing the 75th percentile within the dataset. Notably, within this specific subset, it is evident from the correlation matrix (*Table 10*) that a positive correlation of 0.128 exists between Research and Development Intensity (RDI) and the number of Patents (PAT). This correlation stands in contrast to the dynamics observed in the main model. Another distinctive characteristic of this subset is the observation that RDI no longer maintains statistical significance, as indicated by a p-value exceeding 0.10. This implies that, within this subset, RDI no longer offers an explanatory contribution to the phenomenon of underpricing. Conversely, PAT remains robustly significant, boasting a p-value of 0.05, while control variables including Total Proceeds (PROC), Firm Size (SIZE), and Trading Volume (VOL) retain their strong statistical significance. In totality, the model continues to elucidate a noteworthy portion of the variance in the dependent variable, with an Adjusted R-squared (Adj.R^2) of 0.270. This observation underscores the

importance of patents in explaining the underpricing phenomenon, even as the significance of R&D intensity diminishes within this particular subset.

Medium companies

The secondary subset, prominently featured in *Column 3*, comprises a total of 136 companies, constituting the second category within this classification. Notably, an examination of this subset reveals that the correlation between Research and Development Intensity (RDI) and the number of Patents (PAT) remains positive; however, it is observed to be extremely close to zero, registering at 0.069 (visible in *Table 12*). In this specific subset, RDI reemerges with a moderate level of significance, with a p-value falling below the 10% threshold. Simultaneously, the significance of the independent variable PAT diminishes, now manifesting at the 10% significance level. Control variables, namely Total Proceeds (PROC), Firm Size (SIZE), and Trading Volume (VOL), continue to exhibit robust statistical significance. It is noteworthy that the Adjusted R-squared for this model experiences a substantial increase, soaring to 0.510, representing the highest value among the four distinct samples considered. This noteworthy shift in the Adjusted R-squared underscores the unique dynamics at play within this subset and emphasizes the potential influence of both RDI and PAT, albeit at varying degrees of significance, in elucidating the underpricing phenomenon.

Small companies

Within *Column 4* of *Table 15*, it is possible to observe the outcomes pertaining to the third subset, which exclusively encompasses small-sized companies. In this context, the correlation between the two independent variables, namely Research and Development Intensity (RDI) and the number of Patents (PAT), maintains a positive orientation but continues to hover at a remarkably low value, specifically registering at a mere 0.021 (visible in *Table 14*). Notably, within this particular subsample, it becomes evident that the sole variable retaining a degree of moderate significance is Total Proceeds (PROC), albeit at the 10% significance level. However, it is paramount to acknowledge that the model presented in this subset only accounts for a meager 6.4% of the overall variance observed in the dependent variable. Consequently, within the context of small-sized companies, as delineated by the selected sample, the variables

incorporated into the model demonstrate a limited capacity to effectively prognosticate the extent of IPO underpricing, underscoring the multifaceted nature of this phenomenon within this specific segment of the market.

6. Conclusions

6.1 Conclusions

This part looks more closely at the conclusions and final observations made as a consequence of the completed research as well as the ramifications of the findings.

The analysis carried out in the earlier chapters yields important findings in relation to the theories supporting the current study. This study demonstrates that IPO underpricing is significantly influenced by the two innovation ability aspects (R&D and patents). The research also contributes to a better understanding of the creation of the IPO underpricing for innovative businesses, such as high-tech companies, in emerging capital markets by expanding the interpretation and application of the information asymmetry theory on the phenomena of IPO underpricing. In addition, through its industrial policy, the Chinese government has actively fostered the enterprises' capacity for innovation and the optimization of their industrial structures in recent years. The IPO price limit regulation was implemented in an effort to increase the effectiveness of resource allocation in the stock market. The unusually high degree of IPO underpricing has been of particular concern to the government as a possible risk to the growth of more effective financial markets, useful to sustain fast-growing businesses.

The findings imply that research and development (R&D) investment, as the primary source of information asymmetry and uncertainty, might result in a significant amount of IPO underpricing for IPO businesses from the standpoint of innovation input. Additionally, the IPO underpricing rate would be larger for IPO enterprises the more money they invest in R&D.

In order to demonstrate their capacity for innovation to the market and ensure the success of their IPOs, the vast majority of IPO businesses want to publish their inventive proprietary information, particularly the number of patent applications and issued patents. Similar to this, using the number of patents as a proxy for this capability, publishing information regarding innovation output can reduce information asymmetry, encourage the market, and aid investors in accurately identifying and assessing the

firm's worth. Therefore, a lower IPO underpricing rate are produced by stronger innovation outcome.

Another important element observable from the model results is the correlation between the two independent variables (i.e. RDI, and PAT), chosen to represent the innovation input and output. Before analyzing the results, it was possible to assume a strong positive correlation between the two variables. However, this hypothesis is only realized in the *Large Companies* sample, while it is weak or negative in all other cases. This implies, on the one hand, that companies in this sector face problems of "effectiveness" or productivity of their R&D investments, and on the other that this phenomenon is linked to the size of the company in question. If for the *Large Companies* sample this correlation is strongly positive as imagined at the beginning, this weakens as the size of the company decreases, thus obtaining fewer patents per unit of expenditure in Research and Development, thus, showing a huge problem for the "effectiveness" of the investments mentioned above.

6.2 Suggestions, Limitations, and Future Research

It is important to comment on a few findings that might be used as a starting point for more studies based on the data attained. As a result, the following paragraphs reflect and suggest ideas, limits, and proposals for future research.

Although the research provides significant and valuable insights into IPO underpricing and innovation, there are a few limitations that must be considered when interpreting and applying the findings of the analysis. The first one concerns how the dataset has been built. It only focuses on one industry (i.e. high-tech industry), therefore choosing another industry may result in different findings for the same analysis. The second one concerns how the R&D Intensity variable (i.e. RDI) has been retrieved. In this thesis R&D Intensity is measured as R&D Expenses on Sales during the IPO year, however other methods of calculation could be used to analyze the intensity of a firm’s investment in research and development, resulting in different findings for the same hypothesis.

The analysis carried out and its limitations lead the readers and the present research to understand the suggestions to provide to future research on the matter. A first suggestion could be to compare the results of this study with a sample of comparable companies in another country where IPO underpricing is still a relevant phenomenon, or where financial markets are more developed than the Chinese one to assess if the relationship between variables still holds or show any differences. An additional suggestion could be to focus on the regulations the Chinese government has implemented to make financial markets more efficient, therefore another research could implement the recent industrial and financial policies to the model to assess the impact on underpricing and innovation.

Summary

Introduction

The exploration of innovation's impact on business, a widely discussed subject, is pivotal for understanding competitiveness (Neely, 2005). Despite proven benefits, debates persist on innovation drivers, especially concerning financial valuation. In the knowledge economy, innovation dictates wealth generation at firm, regional, and national levels.

Numerous studies indicate innovation enhances firm performance by increasing competitiveness and adapting internal capabilities (Neely, 2005). Measurement challenges arise due to innovation's multi-dimensional and context-specific nature, making comparisons difficult. This thesis delves into the link between innovation and a company's decision to go public. Research suggests going public, especially in developed markets like the United States, fosters innovation (Brown et al., 2009; Hsu et al., 2014).

The valuation of IPOs is crucial, given the limited information available at the time. The study addresses the gap in the literature regarding the impact of company size on the relationship between innovation and IPO underpricing. By focusing on high-tech firms in the Chinese market, the research aims to empirically elucidate the influences of innovation-related variables, such as R&D intensity and patents, on IPO underpricing. It extends the information asymmetry theory's application to highlight the role of information disclosure and innovation in mitigating information asymmetry.

The study explores variations in outcomes based on the size of enterprises, offering nuanced insights into the effectiveness of research and development investments. The division of the sample into size categories provides a comprehensive perspective on how innovation influences underpricing during the crucial IPO phase, catering to diverse investor and firm needs. The study suggests avenues for future comparative analysis and emphasizes methodological considerations for refined research in this domain.

Theoretical Framework

The study conducts a comprehensive analysis of pertinent literature, meticulously detailing and scrutinizing the considered variables while forecasting research hypotheses.

The term 'innovation' lacks a universally accepted definition, leading to an exploration of varied definitions tailored to specific fields and contexts. Definitions range from Thompson's (1965) focus on new ideas, processes, products, or services to Damanpour's (1996) emphasis on organizational change. Du Plessis (2007) highlights innovation in knowledge management, considering it the creation of new knowledge to enhance internal processes and market-driven products. In a business context, 'innovation' involves translating ideas into marketable products, equating to the successful realization of novel ideas.

Innovation is pivotal for competitive advantage and economic growth, reshaping a firm's capabilities for adaptability. The study emphasizes the transformative process from ideas to market-driven products.

Scholars recognize the crucial role of innovation in a company's internal value chain. Previous research, such as Griliches (1981), establishes a positive correlation between innovation and a firm's value. However, the study focuses on the unexplored contributions of innovation to IPO pricing and short-term performance.

Empirical evidence indicates heightened creative efforts preceding IPOs, with successful innovation catalyzing companies' transition to publicly traded entities. Financial markets facilitate innovation by providing access to capital, but uncertainty surrounding innovation outcomes complicates valuation, leading to information asymmetry issues. Investments in R&D introduce an information gap for external investors, with agency theory suggesting potential hidden costs.

Contemporary research emphasizes the need for investors to consider innovation-related information for effective evaluation. Innovation input and output, as distinguished by Chen and Xu (2015), have varying implications for investors.

However, the absence of a universally applicable methodology for assessing innovation performance is highlighted, necessitating diverse measures.

The majority of research on innovation and IPO performance has focused on developed countries, particularly the United States. The study underscores the global nature of IPO underpricing, with specific attention to the unique dynamics in the Chinese capital market. Information asymmetry theory is utilized to explore IPO underpricing in China, emphasizing the distinct regulatory features. China's evolving economic landscape, distinct institutional and regulatory features, and policy initiatives for fostering innovation add complexity to research in emerging markets.

An Initial Public Offering (IPO) marks a company's first issuance of equity shares to the public, listing them on a stock exchange. The IPO process involves self-assessment, assembling advisors, due diligence, and preparing an exhaustive prospectus. Determining offering terms and conducting a marketing campaign lead to the final offering price. Post-IPO, the company maintains communication with shareholders, complying with reporting obligations. The dynamic nature of the IPO process, susceptibility to influences, and adherence to jurisdiction-specific regulations highlight the need for professional counsel.

Numerous theories, primarily rooted in the efficient market theory, explain the motivation behind firms going public. These include securing capital, facilitating insider divestment, increasing acquisition potential, enhancing trust, and diversifying ownership structures. The subsequent section delves into the pricing complexity of IPOs, market anomalies, and the underpricing phenomenon.

The pricing of an IPO is intricate due to the absence of a pre-IPO market price and limited company history. Information asymmetry can lead to underpricing, influencing high initial returns, market fluctuations, and long-term performance. The analysis focuses on underpricing, especially in the context of the technology sector in China, where underpricing patterns differ from mature economies.

Underpricing, offering shares below market value on the first trading day, entices investors with profit potential. It helps overcome information gaps, diversifies

investors, and generates positive media coverage. However, intentional or not, underpricing has implications for the issuing company, affecting capital raised.

China's IPO process operates under strict oversight by the China Securities Regulatory Commission (CSRC), with regulatory amendments aimed at aligning practices with global standards. Despite reforms, underpricing in China remains high. The section highlights key reforms in 2010, 2012, and 2013, shaping the IPO landscape and influencing underpricing rates. The institutional characteristics provide a unique backdrop for understanding IPO dynamics.

Government-imposed regulatory frameworks play a crucial role in shaping China's IPO landscape. Reforms in 2010, 2012, and 2013 aimed at improving efficiency, disclosure, and market alignment. The shift from an approval-based to a registration-based system marked a significant transition. Despite reforms, underpricing challenges persisted.

While IPO literature extensively covers value drivers, there's a notable gap in attention toward high-tech firms. These companies, defined by their long-term potential and often extravagant valuations, have transformed consumer behavior. The tech sector, dominating the global IPO landscape, warrants focused exploration, especially in markets like China characterized by high underpricing. Insights into China's unique regulatory framework and institutional structure contribute to understanding market efficiency and financial valuation.

Hypotheses

"Underpriced" shares, where the initial offer price is lower than the first-day closing price, suggest that the management "left money on the table". Literature reveals a prevalent underpricing in IPOs, attributed to information asymmetry, institutional influences, and market dynamics. This study focuses on short-term performance, associating underpricing with the information gap about the company. The primary hypothesis, based on information asymmetry, posits that greater R&D spending leads to more severe IPO underpricing.

Research and development (R&D) spending, often used as an innovation proxy, poses challenges for investors due to its high-risk nature and limited transferability. The asymmetry of information regarding R&D investments, particularly in the Chinese market, contributes to unpredictable IPO underpricing. The hypothesis is based on the premise that higher R&D spending intensifies uncertainty for investors.

Hypothesis 1: Greater R&D spending by firms will result in a more severe IPO underpricing.

Innovation output, represented by patents and technical confidentiality, plays a pivotal role. Patents, as technologically intangible assets, can reduce uncertainty and information asymmetry. Businesses disclosing R&D information during IPOs benefit from lower capital-raising costs and increased market value. The number of patents becomes a critical factor in influencing investor perception and lessening IPO underpricing.

Hypothesis 2: A greater number of patents prior to IPO will result in a lower IPO underpricing.

Data and Methodology

As mentioned before, this study investigates the link between a company's innovative activities and its short-term performance post Initial Public Offering (IPO) from 2014 to 2022. The chosen timeframe strategically excludes the early 2000s, marked by a tech sector decline, and pre-2014, a period of significant IPO-related stock market reforms in China. The upper bound of 2022 ensures up-to-date information.

To form a comprehensive dataset, international high-tech companies with IPOs between 2014 and 2022 were identified using Refinitiv Business Classification. The industries selected include a range of tech sectors like Integrated Hardware & Software, Blockchain & Cryptocurrency, and Financial Technology (Fintech). Various databases, including Refinitiv Eikon Datastream, Orbis, Orbis Intellectual Property, and Bloomberg, were employed to extract necessary data for regression analysis, covering variables like proceeds, venture capital presence, stock prices, offer price, total assets,

and book-runner details. In cases where data were unavailable, alternative sources like Yahoo! Finance were used, with the exclusion of companies lacking requisite information to maintain data integrity.

The final sample comprises 274 Chinese high-tech IPOs listed on the Shanghai and Shenzhen stock exchanges.

The equation considered to examine the association between the IPO underpricing phenomenon and the innovation degree of a company is as follows, adapting the regression model to the goals of this study:

$$UP = \beta_0 + \beta_1 * RDI + \beta_2 * PAT + \beta_3 * control\ variables + \epsilon$$

Where:

- UP is the dependent variable;
- RDI (R&D Intensity), and PAT (Patents) are the independent variables;
- $control\ variables$ represents all the control variables chosen to perform the analysis

All the variables used in the present study are summarized and explained in the table below.

Variables Definition

Variable	Definition	Data source
IPO underpricing (UP)	Natural logarithm of first-day return.	Bloomberg
Innovation input (RDI)	Natural logarithm of R&D intensity as ratio of R&D expenses to sales at IPO year.	Bloomberg
Innovation output (PAT)	Natural logarithm of Number of patent applications and acquired patents.	Orbis Intellectual Property
Total proceeds (PROC)	Natural logarithm of total proceeds as total issue volume times issue price.	Refinitiv Eikon

Size (SIZE)	Natural logarithm of total assets before offering.	Refinitiv Eikon
Trading volume (VOL)	Natural logarithm of IPO trading volume.	Refinitiv Eikon
Firm age (AGE)	Number of years between the founding year and listing year.	Refinitiv Eikon, Orbis
Underwriter reputation (UW)	Dummy variable, which denotes 1 for ‘prestigious underwriter’ and 0 for ‘otherwise’.	Refinitiv Eikon
Venture capital (VC)	Dummy variable, which denotes 1 for 'venture capital present at IPO' and 0 for 'otherwise'.	Refinitiv Eikon

In addition, the main dataset composed by the 274 selected companies, was then divided into three separate categories according to the Total Assets of each company, using the 25th and 75th percentile values as the dividing thresholds. This categorization was undertaken with the specific aim of investigating whether distinct patterns emerged, in contrast to the entire sample, in the connections between the selected variables depending on the company's size.

Main Sample Results

The research hypothesis, examining the impact of innovation proxies (R&D Intensity and number of patents) on IPO underpricing in the Chinese market, was tested on the entire sample of 274 observations.

The correlations between these variables are evident. Notably, a positive correlation of 0.074 is identified between IPO underpricing and R&D Intensity, while a negative correlation of -0.196 is observed between IPO underpricing and the number of patents.

These correlations are consistently reflected in the subsequent regression analysis, with estimated coefficients of 0.446 and -0.021, respectively. Both coefficients demonstrate statistical significance at a 5% level. Essentially, the results

suggest that higher R&D Intensity correlates with increased IPO underpricing, whereas a greater number of patents in the company's portfolio tends to alleviate the extent of IPO underpricing.

Size-Based Analysis

To comprehensively explore the impact of innovation on immediate performance, specifically IPO underpricing, the primary dataset was stratified based on Total Assets into three categories using the 25th and 75th percentiles. This size-based segmentation aimed to uncover variations in the relationships among designated variables based on firm size. The analysis delves into the efficiency of Research and Development (R&D) investments and their effects on underpricing, considering firm size.

The subset of 69 large companies (representing the 75th percentile) reveals a positive correlation (0.128) between Research and Development Intensity (RDI) and the number of Patents (PAT), differing from the main model. Notably, RDI loses statistical significance while PAT remains robustly significant (p-value = 0.05). Control variables, including Total Proceeds (PROC), Firm Size (SIZE), and Trading Volume (VOL), retain significance, explaining 27% of the variance (Adj. R-squared).

The 136 medium-sized companies, displaying a positive but nearly zero correlation (0.069) between RDI and PAT. RDI regains moderate significance (p-value < 10%), while the significance of PAT diminishes to the 10% level. Control variables remain highly significant, and the model's Adjusted R-squared increases substantially to 0.510, highlighting unique dynamics.

The outcomes for the third subset, consisting of small-sized companies, indicate a positive but low correlation (0.021) between RDI and PAT. Notably, only Total Proceeds (PROC) retain moderate significance (p-value < 10%). This subset model explains a meager 6.4% of the variance in IPO underpricing, emphasizing the limited predictive capacity of incorporated variables within this specific market segment.

Conclusions: Suggestions, Limitations, and Future Research

The study reveals that Initial Public Offering (IPO) underpricing is significantly influenced by two facets of innovation ability—Research and Development (R&D) and patents. The research contributes to a nuanced understanding of IPO underpricing in innovative businesses, particularly high-tech companies in emerging capital markets, by applying and expanding the information asymmetry theory. The Chinese government's active role in fostering innovation and optimizing industrial structures, coupled with IPO price limit regulations, reflects efforts to enhance resource allocation efficiency.

The study suggests that higher R&D investment increases IPO underpricing due to information asymmetry and uncertainty. Companies publish inventive information, especially patent data, to showcase innovation capacity and reduce information asymmetry, leading to lower IPO underpricing. The correlation between innovation input (R&D investment) and output (patents) varies across company sizes. While a strong positive correlation is observed in large companies, it weakens or turns negative in other cases, indicating challenges in the effectiveness or productivity of R&D investments, particularly in smaller companies. Despite valuable insights, the study has limitations. The focus on the high-tech industry and the specific calculation of R&D Intensity might limit generalizability. Future research could explore other industries or alternative methods of measuring R&D intensity for a broader perspective. Additionally, comparing results with companies in different countries or examining the impact of recent Chinese government policies on underpricing and innovation could provide further insights.

Bibliography

Aboody, D., & Lev, B. (2000). Information asymmetry, R&D, and insider gains. [J]. *The journal of Finance*, *55*(6), 2747-2766.

Adams, R., Bessant, J., & Phelps, R. (2006). Innovation management measurement: A review. [J]. *International journal of management reviews, 8*(1), 21-47.

Allen, F., & Faulhaber, G. R. (1989). Signalling by underpricing in the IPO market. [J]. *Journal of financial Economics, 23*(2), 303-323.

Barth, M. E., & Kasznik, R. (1999). Share repurchases and intangible assets. [J]. *Journal of accounting and economics, 28*(2), 211-241.

Bartov, E., Mohanram, P., & Seethamraju, C. (2002). Valuation of internet stocks—an IPO perspective. [J]. *Journal of Accounting Research, 40*(2), 321-346.

Baker, M., & Wurgler, J. (2007). Investor sentiment in the stock market. [J]. *Journal of economic perspectives, 21*(2), 129-151.

Bernstein, S. (2015). Does going public affect innovation?. [J]. *The Journal of finance, 70*(4), 1365-1403.

Boulton, T. J., Smart, S. B., & Zutter, C. J. (2011). Earnings quality and international IPO underpricing. [J]. *The Accounting Review, 86*(2), 483-505.

Brau, J. C., & Fawcett, S. E. (2006). Initial public offerings: An analysis of theory and practice. [J]. *The journal of Finance, 61*(1), 399-436.

Brown, J. R., Fazzari, S. M., & Petersen, B. C. (2009). Financing innovation and growth: Cash flow, external equity, and the 1990s R&D boom. [J]. *The Journal of Finance, 64*(1), 151-185.

Carter, R., & Manaster, S. (1990). Initial public offerings and underwriter reputation. [J]. *the Journal of Finance, 45*(4), 1045-1067.

Chahine, S., Arthurs, J. D., Filatotchev, I., & Hoskisson, R. E. (2012). The effects of venture capital syndicate diversity on earnings management and performance of IPOs in the US and UK: An institutional perspective. [J]. *Journal of Corporate Finance, 18*(1), 179-192.

Chan, K., Wang, J., & Wei, K. J. (2004). Underpricing and long-term performance of IPOs in China. [J]. *Journal of Corporate Finance, 10*(3), 409-430.

Chemmanur, T. J., & Fulghieri, P. (1999). A theory of the going-public decision. [J]. *The review of financial studies, 12*(2), 249-279.

Chen, C., & Xu, H. (2015). The Roles of Innovation Input and Outcome in IPO Pricing—Evidence from the Bio-Pharmaceutical Industry in China. [D]. *Fudan University, Working Paper.*

Cheung, Y. L., Ouyang, Z., & Weiqiang, T. A. N. (2009). How regulatory changes affect IPO underpricing in China. [EB]. *China Economic Review, 20*(4), 692-702.

China Securities Regulatory Commission. (2020) CSRC Annual Report 2020 [R].

Cohen, L., Diether, K., & Malloy, C. (2013). Misvaluing innovation. [J]. *The Review of Financial Studies, 26*(3), 635-666.

Damanpour, F. (1996). Organizational complexity and innovation: developing and testing multiple contingency models. [J]. *Management science, 42*(5), 693-716.

Du Plessis, M. (2007). The role of knowledge management in innovation. [J]. *Journal of knowledge management, 11*(4), 20-29.

Ernst & Young. (2022) EY Global IPO Trends 2022 [R].

Filatotchev, I., & Bishop, K. (2002). Board composition, share ownership, and 'underpricing'of UK IPO firms. [J]. *Strategic management journal, 23*(10), 941-955.

Geertsema, P., & Lu, H. (2019). Regulated price and Demand in China's IPO market. [J]. *Journal of Economics and Business, 106*, 105846.

Gompers, P. A. (1996). Grandstanding in the venture capital industry. [J]. *Journal of Financial economics, 42*(1), 133-156.

Griliches, Z. (1981). Market value, R&D, and patents. [J]. *Economics letters, 7*(2), 183-187.

Griliches, Z. (1990). Patent statistics as economic indicators: 1990. [EB]. *National Bureau of Economic Research*.

Guo, R. J., Lev, B., & Shi, C. (2006). Explaining the Short-and Long-Term IPO Anomalies in the US by R&D. [J]. *Journal of Business Finance & Accounting, 33*(3-4), 550-579.

Guo, R. J., Lev, B., & Zhou, N. (2005). The valuation of biotech IPOs. [J]. *Journal of accounting, auditing & finance, 20*(4), 423-459.

Gupta, S., & Lehmann, D. R. (2003). Customers as assets. [J]. *Journal of Interactive marketing, 17*(1), 9-24.

Hall, B. H., Jaffe, A., & Trajtenberg, M. (2005). Market value and patent citations. [J]. *RAND Journal of economics*, 16-38.

Heeley, M. B., Matusik, S. F., & Jain, N. (2007). Innovation, appropriability, and the underpricing of initial public offerings. [J]. *Academy of Management Journal, 50*(1), 209-225.

Higgins, M. C., & Gulati, R. (2000). Getting off to a good start: the effects of upper echelon affiliations on prestige on investment bank and IPO success. [EB]. *In Academy of Management Conference*, Toronto.

Hirshleifer, D., Hsu, P. H., & Li, D. (2013). Innovative efficiency and stock returns. [J]. *Journal of financial economics, 107*(3), 632-654.

Hsu, P. H., Tian, X., & Xu, Y. (2014). Financial development and innovation: Cross-country evidence. [J]. *Journal of financial economics, 112*(1), 116-135.

Huyghebaert, N., & Xu, W. (2016). Bias in the post-IPO earnings forecasts of affiliated analysts: Evidence from a Chinese natural experiment. [J]. *Journal of Accounting and Economics, 61*(2-3), 486-505.

Ibbotson, R. G. (1975). Price performance of common stock new issues. [J]. *Journal of financial economics, 2*(3), 235-272.

Ibbotson, R. G., Sindelar, J. L., & Ritter, J. R. (1994). The market's problems with the pricing of initial public offerings. [J]. *Journal of applied corporate finance, 7*(1), 66-74.

Jones, D. A. (2007). Voluntary disclosure in R&D-intensive industries. [J]. *Contemporary Accounting Research, 24*(2), 489-522.

Jong, A. D., Huijgen, C. A., Marra, T. A., & Roosenboom, P. (2012). Why do firms go public? The role of the product market. [J*]. Journal of Business Finance & Accounting, 39*(1-2), 165-192.

Kelm, K. M., Narayanan, V. K., & Pinches, G. E. (1995). Shareholder value creation during R&D innovation and commercialization stages. [J]. *Academy of management Journal, 38*(3), 770-786.

Kimberly, J. R., & Evanisko, M. J. (1981). Organizational innovation: The influence of individual, organizational, and contextual factors on hospital adoption of technological and administrative innovations. [J]. *Academy of management journal, 24*(4), 689-713.

Le, S. A., Walters, B., & Kroll, M. (2006). The moderating effects of external monitors on the relationship between R&D spending and firm performance. [J]. *Journal of Business Research, 59*(2), 278-287.

Leland, H. E., & Pyle, D. H. (1977). Informational asymmetries, financial structure, and financial intermediation. [J]. *The journal of Finance, 32*(2), 371-387.

Lev, B. (2001). Intangibles: Management, Measurement, and Reporting. [EB]. *The Brookings Institution*. Washington DC, USA.

Li, Y., (2006). Comparison and analysis of American and Japanese industry policies and the inspiration. [EB]. *Econ. Surv 1*, 48–50.

Lin, Z. J., & Tian, Z. (2012). Accounting conservatism and IPO underpricing: China evidence. [J]. *Journal of International Accounting, Auditing and Taxation, 21*(2), 127-144.

Ljungqvist, A. (2008). Handbook of Empirical Corporate Finance, Volume 2 (Handbooks in Finance). [M]. *Eckbo Ed.*, Amsterdam, North-Holland.

Loughran, T., Ritter, J. R., & Rydqvist, K. (1994). Initial public offerings: International insights. [J]. *Pacific-Basin Finance Journal, 2*(2-3), 165-199.

Lowry, M. (2003). Why does IPO volume fluctuate so much?. [J]. *Journal of Financial economics, 67*(1), 3-40.

Maksimovic, V., & Pichler, P. (2001). Technological innovation and initial public offerings. [J]. *The Review of Financial Studies, 14*(2), 459-494.

Modigliani, F., & Miller, M. H. (1963). Corporate income taxes and the cost of capital: a correction. [EB]. *The American economic review*, 433-443.

Mok, H. M., & Hui, Y. V. (1998). Underpricing and aftermarket performance of IPOs in Shanghai, China. [J] *Pacific-Basin Finance Journal, 6*(5), 453-474.

Myers, S. C. (1984). Capital structure puzzle. [M].

Neely, A., Gregory, M., & Platts, K. (2005). Performance measurement system design: A literature review and research agenda. [J]. *International journal of operations & production management, 25*(12), 1228-1263.

Nord, W. R., & Tucker, S. (1987). Implementing routine and radical innovations. [M].

Pakes, A. (1985). On patents, R & D, and the stock market rate of return. [J]. *Journal of political economy, 93*(2), 390-409.

Pastor, L., & Veronesi, P. (2009). Learning in financial markets. [EB]. *Annu. Rev. Financ. Econ., 1*(1), 361-381.

Popper, B. (2017). The tech sector is leaving the rest of the US economy in its dust. [EB]. [Online] Available at: www.theverge.com, May 16, 2017

Rajgopal, S., & Shevlin, T. (2002). Empirical evidence on the relation between stock option compensation and risk taking. [J]. *Journal of accounting and economics, 33*(2), 145-171.

Reichheld, F. F., & Schefter, P. (2000). E-loyalty: your secret weapon on the web. [J]. *Harvard business review, 78*(4), 105-113.

Ritter, J. R., & Welch, I. (2002). A review of IPO activity, pricing, and allocations. [J]. The journal of Finance, 57(4), 1795-1828.

Scott Jr, J. H. (1976). A theory of optimal capital structure. [J]. *The bell journal of economics*, 33-54.

Thompson, V. A. (1965). Bureaucracy and innovation. [EB]. *Administrative science quarterly*, 1-20.

Van de Ven, A. H. (1986). Central problems in the management of innovation. [J]. *Management science, 32*(5), 590-607.

West, M. A., & Anderson, N. R. (1996). Innovation in top management teams. [J]. *Journal of Applied psychology, 81*(6), 680.

Wong, P. K., Lee, L., & Foo, M. D. (2008). Occupational choice: The influence of product vs. process innovation. [EB]. *Small Business Economics*, 30, 267-281.

Xu, X., Xia, Y., Chun-tao, Li, (2016). Indigenous corporate R&D, IPO underpricing and signaling of innovation capability: an empirical research on listed companies of ChiNext [D].

Yiu, L. D., Lam, H. K., Yeung, A. C., & Cheng, T. C. E. (2020). Enhancing the financial returns of R&D investments through operations management. [EB]. *Production and Operations Management, 29*(7), 1658-1678.

Zhang, W. Y. (2016). Why is industry policy doomed to fail. [EB]. *China Chain Store*, 11, 84-86.

Zhang, X. Y., & Zhang, Y. (2016). Venture capital, innovation capability and post-IPO performance. [J]. *Economic Research Journal, 51*(10), 112-125.

Zhao, Jian, (2008). China's comparative advantage on self-determined R&D and industrial policy – based on capabilities theory of the firm. [EB]. *China Ind. Econ. 2015* (8), 76–86.

Zhou, L. J., & Sadeghi, M. (2019). The impact of innovation on IPO short-term performance–evidence from the Chinese markets. [J]. *Pacific-Basin Finance Journal*, 53, 208-235.

Zhu, H., Zhang, C., Li, H., & Chen, S. (2015). Information environment, market-wide sentiment and IPO initial returns: Evidence from analyst forecasts before listing. [J]. *China Journal of Accounting Research, 8*(3), 193-211.

Acknowledgements

I would like to express my deepest gratitude to my supervisor and Luiss academic coordinator of the Double Degree in International Management program Professor Giovanni Fiori, who introduced the program, helped the whole group during the most uncertain times, and always guided me to make thoughtful decisions for my academic and professional career

I am grateful to Professor Jonathan Berkovitch, for guiding me through the completion of this thesis, his suggestions during the writing were extremely useful and thought-provoking to successfully conclude the work and the experience.

Additionally, this experience would not have been possible without the support from my two universities, Luiss Guido Carli and Fudan University, and their respective staff, for their support that made me feel like a part of a big family.

I am also grateful to all the people I had the chance to meet and knew better during one of the most important experiences of my life, my flatmates in Shanghai, Ornella, Federica, and, Beatrice; all my university colleagues, my friends in Italy who always checked on me, and many other friends I met along the journey.

Lastly, my mother Morena, my father Franco, and my sister Alessandra. This experience would have not been possible without their never-ending support which kept my spirit and motivation high during the whole experience, especially in the darkest times.

To all of you, thank you.

Gianluca