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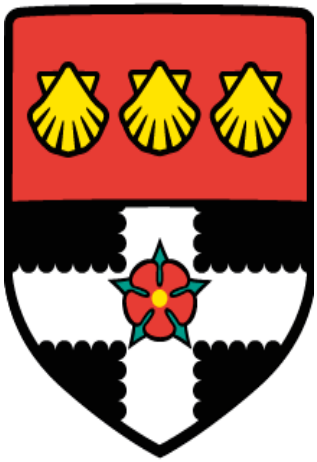

ESSAYS ON IPO UNDERPRICING: AN ECONOMIC APPROACH

A THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

BY

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DECLARATION

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.

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ABSTRACT

Regardless of the huge body of literature on the short-run performance of initial public offerings (IPOs), the anomaly remains unsolved and there are still less explored areas, mainly due to a lack of data availability and methodology restrictions. This thesis aims to provide a better understanding of IPO valuation and initial returns with an economic approach, which is new to the focus of current literature on firm- and issuing-characteristics. Specifically, this thesis introduces three new macroeconomic determinants in an IPO valuation, including the country-level financial integration, regional economic openness and geographic business/investment location of real assets, by focusing on the cross-country and real estate IPOs.

Due to the already mentioned restrictions on data and methodology, the analysis of this thesis is carried out on three studies, each with a unique and different dataset. The results show that a country's financial integration reduces IPO initial returns, along with the country-level institutional settings. Alongside this direct effect, the results also suggest a moderation effect where financial integration weakens the impact of country institutions on IPO underpricing. Furthermore, in the second study, urban economic openness at a regional (or city) level within a country is found to reduce IPO initial returns. We use the laboratory of real estate IPOs in China, where we observe high underpricing and cross-sectional variation in openness between regions. As this impact is transmitted through the geographic location of a company's underlying real assets, the final study shows how this geographic factor matters for U.S. Real Estate Investment Trust (REIT) IPOs. The findings reveal a negative relationship between the geographic diversification of the underlying properties and IPO initial returns. Overall, this thesis highlights the importance of the macroeconomic conditions surrounding the issuing company to its IPO valuation.

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Chapter 1 : Introduction

Despite the vastly increased awareness that the public has of the importance of financial markets and hugely improved involvement that individuals and households have in all kinds of financial activities, initial public offering (or IPO, both are used interchangeably hereafter) remains an exciting field of research and its dynamics are still not fully uncovered. An IPO is almost like a 'debut' before which little is known about the issuing company and the IPO market is often the 'stage' for large institutional investors. The significance and importance of an IPO cannot be over-estimated and an IPO has the potential to raise a staggering amount of money as evidenced by numerous headline-grabbing IPO deals in recent history.

An IPO represents a milestone in the life of a company where it completes its transition from a private company to a public one. A number of advantages and opportunities come with the completion of an IPO. The access to the public capital markets promises a wider selection of financing resources with lower cost of capital, supporting the future growth of a company. Being publicly traded can also add intangible values such as increasing the recognition and reputation among both investors and customers. Public companies need to meet strict regulations at all times which hugely improves their transparency and the quality of disclosures compared to private companies. However, all these benefits come with a price, not to mention that IPOs also bring in some disadvantages and new problems. An IPO is a complex process involving a number of professional parties, requiring sufficient time and preparation and accruing substantial costs, both direct and indirect, for the issuing company. Even after all this time and money invested in the research and preparation stage, completion of an IPO is never guaranteed. According to Allison et al. (2008), around 7 out of 10 companies which filed IPOs with the Security and Exchange Commission (SEC) in the U.S. between 2002 and 2007 had actually completed the IPOs. In other words, the withdrawal rate was around 30%.

Due to the considerable size of the IPO market and the complexity of its process, IPO as a field has generated abundant research questions among which the anomalies of the short- and long-run performance of the IPO shares have become the centre of attention. This thesis focuses on the anomaly in the short-run performance of IPOs, also widely-known as underpricing[1].

1.1 Motivation

IPO underpricing represents the extent of the price increase of the first trading day (from offer to closing price), which is commonly referred as 'initial returns'. As an anomaly, underpricing occurs when the average initial return of the IPOs is significantly above zero. In other words, the IPO offer price is set much lower than what the market is willing to pay. By leaving money on the table, IPO underpricing also represents a transmission of wealth from the issuers to the investors. This underpricing anomaly has been observed throughout different time periods and across many countries.

The research on the underpricing anomaly carries great importance. In today's world, exciting stories surrounding IPOs are everywhere in the news and the record of the amount of money that an IPO can raise keeps being broken. When Alibaba, an online ecommerce company in China, went public on New York Stock Exchange on 18th September 2014, it soon claimed the title of the world's largest IPO and was breaking news across the globe. Compared to the substantial amount of money that the IPOs raise, underpricing seems too trivial to be overly concerned with. However, the amount of money that an IPO can potentially leave behind due to underpricing is also substantial and cannot be neglected.

[1] In the IPO literature, the short-run performance usually refers to first-day return on the offer price of the IPO, which is also commonly referred as 'IPO initial returns'.

To take just a few IPOs as examples. Storage Networks, the first U.S. company providing data storage service, went public on 30th June 2000. The offers were priced at $27 per share and 9 million shares were sold making the total proceeds $243 million. The first-day trading closed at $90.25 per share resulting in an incredibly high initial return or underpricing of 234.26%. As a result, 569.25 million dollars, which could have gone to the issuers if the IPO was priced at the market price ($90.25 per share), were left on the table. In the end, the diluted wealth of the issuers was more than double what they raised in the IPO and it became hard to tell whether it was a success or failure. This might seem an extreme case, but even if the level of underpricing is relatively small, it is still very likely that a significant amount of money will be left behind. General Motors went public in 2010 and experienced a 3.6% underpricing which was below the average of 9.4% that year. With an offer price of $33 per share and 478 million shares sold, they still left $568.82 million for the investors. When it comes to some of the largest IPOs in history, the numbers become even more astonishing. For example, with 28.41% and 38.7% underpricing, Visa and Alibaba left 5.075 and 9.517 billion dollars on the table, respectively. This phenomenon is certainly not exclusive to the U.S. market. For example, one of the biggest IPOs in the media industry in China—Phoenix Publishing & Media, Inc—experienced 34.77% underpricing, leaving 1.56 billion Chinese Yuan (around 241.5 million U.S. dollars). Guotai Junan Securities Co. Ltd, one of the largest investment companies in China, issued an IPO in 2015 which raised 30.06 billion Chinese Yuan and left about 13.22 billion Chinese Yuan behind.[2] According to Ritter (2017), a total of 155.14 billion dollars was left on the table between 1980 and 2016 for U.S. IPOs alone.[3] With all these numbers, it is not difficult

[2] The average exchange rate between U.S. dollar and Chinese Yuan is 6.22 in 2015.

[3] The data is from Jay Ritter's website http://site.warrington.ufl.edu/ritter, which has the most comprehensive statistics on IPOs in the U.S. and some other countries. The data is regularly updated. For the methodology used to calculate the total money left on the table, please refer to the file 'Initial Public Offerings: Underpricing' on the website.

to understand why IPO underpricing has long been a strong research area and still considered as one of the most famous financial puzzles today.

The literature on IPO underpricing is substantial and well-developed. There are quite a few established theories and models followed by a large number of empirical studies. However, not one single theory or model can account for all the underpricing and there are still questions which remain unsolved. There are different ways to categorize the underpricing literature. In this thesis, we follow the most common way as proposed by Ritter and Welch (2002) and categorize the literature into classic theories that are based on the information-asymmetry assumptions, behavioural arguments, and other studies that could belong to either or none of the above.

A detailed review of the literature on IPO underpricing can be found in Chapter 2 and is structured based on the above categories. In short, classic theories are based on the assumption that there is information asymmetry existing in the valuation of the IPO company and underpricing is a result of this information asymmetry of which different channels or mechanisms are proposed by different theories. While the classic theories place an obvious focus on the pre-IPO valuation, the behavioural arguments generally believe that the level of underpricing is at least partly explained by the market sentiment. Most of the remaining studies focus on the allocation process of IPOs and the conflicts between parties involved in this process, including the role of underwriters.

A common theme of the different branches of the mainstream underpricing literature is the focus on firm- and issuing-level characteristics rather than wider economic or institutional factors. Real estate IPOs are often excluded from studies on industrial IPOs not only because real estate is grouped under FIR (finance, insurance and real estate) industries but also that real estate IPOs experience much lower initial returns, as compared to industrial IPOs. This

phenomenon is especially significant in the U.S. and before the 1990s. With both real estate companies and the institutional regime for this industry undergoing significant transformation, the patterns of real estate IPO pricing have also changed. After the 1990s, real estate IPOs have become, on average, underpriced, and most of the empirical studies find weak or no explanatory power in the existing theories, which apply to industrial IPOs, on the variation of real estate IPO performance. Therefore, the pattern of real estate IPO performance remains somewhat mysterious and needs further investigation. The other branch of literature which needs more attention relates to cross-country IPO studies. In fact, up to the 2010s the majority are domestic studies despite the fact that underpricing is a world-wide phenomenon and presents a significant variation between countries. A limited number of studies emerging in the last decade find country-level institutional settings account for a significant proportion of variation in firm-level underpricing, aside from firm- and issuing-level characteristics. This branch of studies has emerged only recently and the whole picture of the cross-country IPO performance is far from being fully revealed.

This thesis adds to the literature by focusing on the insufficiently explored areas discussed above and proposes new drivers of IPO short-run performance by adopting an economic approach. Based on and beyond the previously acclaimed theories and models, this thesis looks at macroeconomic and institutional determinants which have not been explored in previous literature. Specifically, the investigations relate to country-level financial integration and institutional settings, domestic regional economic openness, as well as geographic location factors. To empirically study the roles of economic factors in firm-level finance activities can be problematic due to data availability and methodologies. In this thesis, a diverse database has been contributed with a number of different methodologies applied to uncover the above relationships.

1.2 Outline of the Thesis and Contributions

In Chapter 2, a detailed review of the literature on IPO underpricing is presented, following a brief summary of the research on IPO decisions. The studies are categorized into five groups of which the first three groups include classic theories, behavioural arguments and other studies, presented in Sections 2.3, 2.4 and 2.5 respectively. Section 2.6 presents the fourth group which is dedicated to IPO studies with real estate samples which are often excluded by mainstream studies. While some of the real estate IPO studies could also be categorized into classic theories, the focus is given to the special characteristics of the real estate industry and how these IPOs are different from industrial IPOs. The last group contains recent studies on the cross-country IPO performance, presented in Section 2.7.

Chapter 3 builds on the very recent literature analysing the role of financial integration on IPO markets and adds to the literature with a first attempt to empirically test the impact of financial integration on IPO underpricing. Specifically, the argument that international financial integration at the country level negatively impacts on IPO underpricing, both directly and indirectly, is investigated. For this purpose, a large cross-country dataset has been adopted and the use of hierarchical linear modelling employed. Firstly, international financial integration of a country is found to negatively affect the level of IPO underpricing. Secondly, a moderation effect of international financial integration is also detected which weakens the explanatory power of the country institutions in the cross-country variation of IPO underpricing. The results stand through alternative proxies for international financial integration and different model specifications.

The contributions of this study are threefold. First of all, it extends the existing literature on cross-country IPO performance by revealing a new significant determinant—international financial integration. As this impact is transmitted through an improved financial

intermediation process, both domestic and foreign IPOs are affected by the financial integration process. Secondly, although previous cross-country studies have established the importance of a country's institutional settings, especially the legal system, on the firm-level IPO underpricing, this study presents new evidence that the influences of a country's institutions are weakened by the increasing level of its financial integration with the rest of the world. This result acts as further evidence supporting the general argument in the globalization literature that financial integration makes a country's institutional settings matter less in capital markets. Finally, to be able to link the macro-level factors with the firm-level underpricing, we adopt hierarchical linear modelling (sometimes referred to as 'multi-level modelling') to deal with the structural problems existing in a large cross-country dataset. This adds to the methodology commonly adopted in the IPO literature which uses ordinary least square (OLS) estimations.

Having proved the importance of the macroeconomy in IPO underpricing, the remaining two chapters focus on real estate companies, which provide a unique laboratory in which to study the impact that regional economic factors within a country may have on short-run performances of IPOs.

In Chapter 4, the study extends the scope of Chapter 3 and investigates how regional differences in economic openness may affect underpricing within a country where legal institutions are the same across all regions.

Specifically, it examines the empirical impact of urban economic openness on the short-run underpricing of initial public offerings, using city-level real estate data. We argue that urban economic openness has a significant impact on the productivity and prices of both direct and indirect real estate through productivity gains of companies in more open areas as well as through the Balassa-Samuelson effect. This in turn positively affects the firm's profitability, enhancing the confidence in the local real estate market and the future company performance

and, therefore, decreasing the uncertainty about the IPO valuation. As a result, issuers have less incentive to underprice the IPO shares, evidenced by a negative relationship between the level of urban economic openness and the level of IPO underpricing.

The main issue in finding a suitable laboratory for this analysis lies in the presence and measurability of both regional patterns of operations at company level and regional heterogeneity of economic openness. The Chinese real estate sector provides a unique dataset that makes empirically testing this relationship feasible. Firstly, Chinese real estate companies show strong geographic patterns focusing their businesses locally—usually at a city level. Secondly, a significant heterogeneity in the degree of openness across Chinese cities is observed. Controlling for company-specific variables, IPO location and state ownership, we find that IPO companies whose businesses are in more economically open areas experience significantly less underpricing. The results show high explanatory power and are robust to diverse specifications as well as different mythologies (2SLS).

This study not only complements the study in Chapter 3, but it also represents a first attempt to demonstrate the relationship between firm-level underpricing and regional economic openness, which also adds to the recent literature on the impact of regional trade openness on asset prices. Since most of the existing theories are incapable of doing this, it identifies a new approach by which to investigate the extreme underpricing in other emerging markets where there is usually a great variance among regional economic development. By using real estate IPOs, the study also shows how the non-tradable nature of the asset class can lead to different drivers of IPO underpricing.

On one hand, Chapter 5 further explores this indication on the underpinning of real asset holdings. On the other hand, it goes beyond the openness factors and introduces another macroeconomic factor—the geographic factor—into the valuation of real estate IPOs. This

study focuses on the U.S. market where real estate IPOs present the most significant difference from industrial IPOs. Following recent developments in the asset pricing literature on geographic diversification, this study explains the short-run performance of REIT IPOs over time with a new approach beyond classic theories based on the assumption of information asymmetry.

Although geographic determinants have attracted attention from academics for a long time, testing them on corporate finance activities is difficult due to data limitations. This study advances the literature presenting the first empirical test on the geographic influence on IPOs by exploring the special characteristics of real estate companies, which have unmoveable assets and are more prone to geographic factors. This study adopts a new model to explain real estate IPO performance, without assuming information asymmetry which would not be able to explain the negative initial returns of real estate IPOs. Finally, unlike previous studies which tend to adopt ad-hoc measures of geographic factors due to methodological limitations, the actual geographic diversification at the state level is constructed manually according to the holdings of property assets in different locations. This method of geographic variable construction can also be used in other corporate finance studies.

By focusing on the U.S. market, we have access to the detailed firm-level data of real estate companies which are reported in the IPO prospectuses. A more diversified REIT is found to have less incentive to underprice or even overprice the IPO shares, which supports the argument that a more concentrated REIT, both at asset-type level and geographically, faces lower investment recognition and therefore more underpricing is needed to attract sufficient subscriptions. Even if both types of diversification are significant, geographic diversification shows a stronger impact on initial returns than property type diversification. This argument and the deadweight cost theory complement each other as lower deadweight cost associated with

the IPO weakens the influence of the geographic diversification on the initial returns of IPOs. Results are robust to different measures of private market returns and time fixed effects and we show that a Herfindahl Index should be preferred as a measure of geographic diversification. The findings provide indications to issuers and investors on the IPO valuation of real estate companies. This approach can also be extended to other industries with similar features, i.e. substantial holdings in real assets, conditional on data availability.

All three studies are descended from an economic perspective and provide evidence that macroeconomic conditions cannot be neglected when it comes to IPO valuations. Along with introducing a novel macroeconomic perspective in the literature focused on the determinants of IPO underpricing, we believe that this thesis contributes to the knowledge in several other ways. Firstly, it provides extra evidences to the heated arguments on the influence of the globalization process on financial markets and corporate finance activities. Secondly, it provides the policy makers with implications concerning how a country's financial and economic developments can affect its companies. It also implies a new angle by which to investigate other corporate finance activities, especially in emerging markets. Finally, it suggests that when investigating the effect of macroeconomic factors on corporate finance we should not simply assume that all the industries are affected in the same way. For example, we find that geographical strategy matters to the real estate IPOs with the impact transmitted via the real asset holdings. With the data technology developing, it is reasonable to expect more macroeconomic factors identified to be relevant to corporate finance decisions. While each study comes with a short summary, the overall conclusions and practical implications drawn from the findings are presented in Chapter 6.

Chapter 2 : Literature Review

2.1 Going Public

Initial public offering (hereafter IPO) refers to a private company going public by offering part or whole of its stocks to the public for the first time. Once the IPO completes, the company's stocks are publicly traded on a stock exchange. Nowhere near being a new concept in financial markets, it has been widely acknowledged that an IPO is an important step in a company's journey of development and growth. With thousands of IPOs taking place around the world, as common as it is, the reasons why companies go public remain complex.

Unlike the anomalies associated with the IPO price performance, why companies go public is a question that has come to attention much later. No matter what the incentives are, there is no doubt that IPOs come with a variety of advantages. It opens the door for the company to abundant external financing opportunities as well as lowering the cost of future capital raising. Most companies go public for financial purposes, such as to raise capital in order to fund their future investments or to provide a simple platform for the shareholders to liquidate their holdings in the future; it is an especially common exit strategy for venture capitalists. IPOs also bring the company non-financial benefits which could be, as minor as they look compared to financial advantages, very rewarding. For example, going public is the most effective way to increase a company's public profile which in turn helps the company to boost its network. However, for all its advantages, an IPO can be a double-edged sword. For example, an IPO will create a dispersed ownership involving more individual investors, which makes it more difficult for the management team to convince the shareholders about investment decisions. Being a publicly listed company also means following the strict regulations regarding the revelation of all the required information to the public on a regular basis, which makes it inevitable that they share a certain amount of privileged information with their rivals.

Going public had long been considered a company's natural choice during its growth process, therefore the complexity of the decision to go public was neglected. It was not until the 1990s that questions around why some companies chose going public over staying private were raised. Initially, the theories about going public were mainly based on the life cycles of companies. Zingales (1995) presents the very first formal theory on going public decisions. He argues that the IPO is a method used by the issuers to maximize the valuation in the future acquisition event, implying that going public is a first step to selling the company in the future. This is supported by Pagano et al. (1998) who find that IPO companies, on average, experience twice as many changes in the controlling of ownership than their rivals which stay private. According to Zingales (1995), by going public, a company's stocks are sold to a large number of smaller investors in the public market, which is much more competitive than the insider block holders. Therefore, it is more difficult for the acquirers to pressurize the dispersed outside investors than the inside block holders about the valuation of the target company. As a result, the value is maximised.

Chemmanur and Fulghieri (1999) develop a more systematic life-cycle theory based on the three main differences between public and private companies, including the levels of ownership concentration, the costs to convince the investors about the new investment plans and the transparency of the stock price. To be more specific, an IPO means the company's stocks will be held by a large number of smaller investors and the ownership is much more dispersed than in the private companies. As a result, the costs of convincing a larger number of smaller shareholders about the company's future investments are increased. However, overall, it becomes easier to evaluate the public companies than the private companies as the transparency is increased. Due to these differences, there are both pros and cons for going pubic as well as selling the shares to private institutional investors, such as venture capitalists. The cost associated with the production of information on the company's value is higher in public

offering because of the large number of small investors. However, when raising the capital privately, the required return by the venture capitalists is usually much higher as they block-hold the shares. As when to go public is really a trade-off between these two factors, Chemmanur and Fulghieri (1999) conclude that companies stay private in the early stages and go public once they have a longer track record which helps to lower the information production cost.

Similar to Chemmanur and Fulghieri (1999), Boot et al. (2006) focus on how the different corporate governance, a by-product of the ownership structure, affects the decisions on going public. Boot et al. (2006) develop a model where disagreements exist between managers and investors, even if there are no agency or asymmetric information problems, simply due to their different beliefs in the future investments. Managers, whose goals are to maximize the company's value, would have concerns that this kind of potential disagreement might jeopardize their value-maximizing decisions. However, naturally, a higher level of autonomy for the managers comes with a higher level of required return by the investors. Private financing gives the managers the best negotiating power over the decision-making autonomy whereas public financing offers the lowest cost of capital and less flexibility on the decision making. Assuming that managers are after the best trade-offs between the decision-making autonomy and the cost of capital, Boot et al. (2006) find that going public is most favoured over private financing when there is a medium level of flexibility of public governance. When the public governance allows the managers too much autonomy, the investors will require a much higher return. Private financing, therefore, is favoured. When the corporate governance allows little autonomy, managers would still prefer private financing, as governance from the public market could be invasive.

Based on the advantages and risks of going public, Maksimovic and Pichler (2001) develop a model in which going public early or late depends on the level of technological risk in the company's industry. They point out that as public trading reveals more information to the company's competitors, i.e. higher public share prices will induce the product market competition, the value of investors' proprietary information is relatively larger in private financing. However, the public offering is more attractive due to the reduced risk of adverse selection. Maksimovic and Pichler (2001) argue that early IPOs occur in industries where the new-entrant risk is dominant and industries with dominant technological risks usually seek private financing first and public financing after the certainty about their new technologies has increased.

As the life-cycle based theories fail to explain that some of the largest companies in the world stay private and some of the big public companies go private again, market-timing based theories start to emerge which predominantly argue that market conditions play an important role in a company's IPO decision. Actually, as early as the life-cycle based theories, long before the market-timing arguments became mainstream, Lucas and McDonald (1990) presented a model based on the adverse selection theory in which the companies, given that the managers are informed, will postpone their IPOs if the market, on average, undervalues the companies. In other words, a cluster of IPOs will happen following a market rise which creates a 'hot issue' market. Lerner (1994) points out that venture capitalists also play a role in the timing of the IPOs. They find that venture capitalists tend to bring the companies to the public when the market is positive or the equity valuation is high. When the equity valuation is relatively low, they tend to guide the companies towards private financing. Gompers (1996) further points out that young venture capitalists tend to bring the companies to the public earlier than mature venture capitalists do, in order to build up their reputation.

Some studies describe an information spillover channel through which the market conditions affect the IPO decisions. For example, in a liquid market where the cost of capital is relatively low, the market price signals useful information to the managers which helps with the investment decisions, making public financing more attractive (Subrahmantam and Titman, 1999). More interestingly, Subrahmantam and Titman (1999) point out that whether the company will benefit more from going public or staying private also depends on the market size and development, i.e. IPOs are preferred in a bigger and more developed market, explaining why IPOs seem more popular in the U.S. than in some European countries.

'IPO waves' refer to the phenomenon when a cluster of companies go public within a short period. Why IPO waves exist is a topic closely related to the decisions to go public. Altı (2005) adopts the information spillover channel to explain the IPO waves and finds that IPO decisions are very sensitive to the recent IPOs as well as the IPO market conditions. Assuming the existence of a common factor in the IPO valuation of which the participating investors are asymmetrically informed, Altı (2005) argues that this private information about the common factor is gradually revealed by the outcomes of previous IPOs because the IPO offer price is set according to the indications of the participating investors' interests. As a result, the valuation for the following IPOs becomes easier, leading to an IPO wave.

Apart from the information-spillover based explanation by Altı (2005), Pástor and Veronesi (2005) develop a theory which considers going public as a real option for the company that will be exercised in the most beneficial conditions in a time-varying market. They divide the market conditions into three dimensions including the expected market returns, expected aggregate profitability and the ex-ante uncertainty about the ex-post average profitability of IPOs. By using the IPO data between 1960 and 2002, they find that all three market conditions contribute to IPO waves. Specifically, IPO waves are more likely to occur when the expected

market return is decreased, expected aggregate profitability is increased or the uncertainty about the ex-post profitability of IPOs is increased.

Chemmanur and He (2011) adopt an approach which refers to the product market competition to analyse the timing of going public and IPO waves. Their model is developed on top of the 'first-mover' advantage argument that those going public early will benefit from grabbing market shares from their competitors who stay private or go public later. Chemmanur and He (2011) provide empirical evidence that companies which go public, or go public early in an IPO wave, experience higher total factor productivity and post-IPO profitability than those companies which stay private, or go public late in an IPO wave, indicating the importance of product market considerations in the timing of IPOs. One counter-argument case to the 'first-mover' advantage, raised by Ritter and Welch (2002), is that the internet software company Spyglass got battered by its competitor Netscape even though Spyglass went public much earlier than Netscape.

2.2 The Anomaly of IPO Underpricing

Unlike the decision on going public, the two anomalies associated with IPO performance, namely the short-run underpricing (hereafter underpricing) and the long-term underperformance of IPOs, have drawn a substantial amount of research interest since the 1970s, leading to a very well-developed literature. Considering the scope and objectives of this thesis, we focus on reviewing the literature on IPO underpricing.

'Underpricing' refers to the excessive initial returns of the IPO shares, which is commonly calculated as the difference between the closing price on the first trading day and the IPO offer price. IPO underpricing is a global phenomenon that has been observed across markets, as recorded by Loughran et al. (1994, updated in 2015). They first reported the levels of IPO underpricing across different time periods for 52 countries in 1994 and have updated the

data frequently since then. Loughran and Ritter (2004) find an average underpricing of 18.9% based on 5980 U.S. IPOs between 1980 and 2002.[4] Wasserfallen and Wittleder (1994) record an average underpricing of 7.58% in Germany from 1961 to 1987. Hill and Wilson (2006) record 11.4% average underpricing in the UK from 1991 to 1998. An average initial return of 29.6% for the Australian IPOs between 1994 and 2004 is documented in Dimovski et al. (2011). In general, the levels of underpricing in the Asian markets are found to be even higher. For example, Kirkulak and Davis (2005) observe an average underpricing of 42.6% for IPOs in Japan. Kim et al. (1993) find an average initial return of 57.5% for South Korean IPOs from 1988 to 1990. In China, an extreme initial return of as high as above 100% or even 200% has been documented in a few studies (Mok and Hui, 1998, Chan et al., 2004, Fan et al., 2007, Tian, 2011). Consistent with previous studies, this thesis also records significant levels of underpricing across countries, with emerging markets generally presenting even higher underpricing than developed markets. For example, it is recorded in Chapter 3 that Mainland China experiences an average underpricing of 50.03% between 1995 and 2011 while the average initial return of IPOs in Hong Kong and the UK is 14.80% and 16.55%, respectively, during the same period. Apart from 'underpricing', the difference between the first trading day closing price and the offer price is also referred to as 'initial return' or 'first-day return' in the literature. In this thesis, we use these terms interchangeably.

2.2.1 The 'Mystery'

In the 1960s, researchers started to show an interest in the initial performance of the newly–listed common shares. Ibbotson (1975) presents the first systematic study on the risk and performance profile of the new common-stock issues from 1960 to 1969 in the U.S.

[4] The average underpricing in the U.S. is updated annually and can be found on Ritter's website: https://site.warrington.ufl.edu/ritter/ipo-data/.

market.[5] He discovered a positive average initial return of 11.4% and argued that the offers were significantly underpriced. With findings that he was unable to explain back then, he called the IPO underpricing a 'mystery'. Even though Ibbotson (1975) did not solve this 'mystery', he provided some possible scenarios and explanations, most of which were intuitive, for the later studies on IPOs.

2.2.2 Initial Attempts to Explain IPO Underpricing

After the underpricing anomaly was discovered in the 1970s, there have emerged numerous studies attempting to explain this phenomenon. Even though few of the early attempts withstood the empirical tests, some of them provided profound intuitions for the later development of the classic theories on IPO underpricing. The principal agency-based explanation by Baron (1982) was one of the very first attempts. He assumes that issuers are less informed about the demand of outside investors than their underwriters. Instead of looking at the actual underwriting process, he argues that it is in the advising and distribution services where issuers are less informed about the capital market. The issuers can neither control nor observe the efforts that the underwriters put into the IPO and in order to induce the underwriters to exploit their superior information in the advising and distribution process, which affects the demand for the unseasoned shares, they delegate the pricing to the underwriters and agree to a certain degree of underpricing as compensation for underwriters sharing their information. One basic assumption of this theory is that the issuers cannot control underwriters' work during the marketing of their IPOs and that underwriters might push for a higher underpricing in their own interests. In order to test this model, Muscarella and Vetsuypens (1989) use a sample of 38 IPOs of investment banks, who are also the underwriters for their own IPOs, from 1970 to 1987. They argue that if Baron's (1982) theory holds, in these 'self-marketed' IPOs where there is no

[5] Other studies around the same period which have recorded this phenomenon include Stoll and Curley (1970), Logue (1973) and Reilly (1973).

information asymmetry between issuers and underwriters, the offer price should fully reflect the market valuations. In other words, there should be no underpricing. However, the empirical result shows a significant underpricing too. Strangely, they find that those investment banks who are also underwriters for themselves experience even greater underpricing. Back then researchers were largely convinced by the findings in Muscarella and Vetsuypens (1989) and believed that Baron's (1982) model did not hold. However, with a better understanding of the roles of underwriters in an IPO, we now know that Muscarella & Vetsuypens's (1989) simple test cannot reject Baron's (1982) theory either. One possible explanation for the significant underpricing of investment banks' IPOs is that the investment banks underprice their initial offers on purpose in order to 'justify' to the public that the underpricing of IPOs is an unavoidable cost (Ritter and Welch, 2002). By doing so, even though they lose out in a one–time event, they profit from constant engagements in the future IPO businesses. A full picture of the roles of underwriters in the IPOs is gradually revealed throughout this chapter.

2.2.3 'Hot Issue' Market

As the first study to examine the 'hot issue' markets, Ibbotson and Jaffe (1975) define hot issues as the unseasoned offerings whose stock prices increase from the offering prices to a level that is significantly higher than the average premium. They further theorise that the 'hot issue' markets are those periods in the market during which the unseasoned common–stock offerings experience unusually high short–run returns. (Ibbotson & Jaffe (1975) examine the first–month returns after listing.) Ritter (1984) studies the 'hot issue' market in the 1980s which confirms the finding of Ibbotson and Jaffe (1975) that there is serial correlation between monthly average returns. To be more specific, Ritter (1984) diagnoses three or four 'hot issue' markets from 1960 to 1982, during which the unseasoned new stocks have experienced abnormally high average monthly returns. For each of those 'hot issue' periods, there is a period following, which sees a significant increase in the numbers of IPOs. To study the time series

behaviour of the 'hot issue' period, Brailsford et al. (2004) use monthly IPO data across 40 years from 1960 to 2000 and identify significant momentum in the new issues market that there is autocorrelation in both the volume and level of underpricing of IPOs.

2.3 Classic Theories on IPO underpricing

Ritter & Welch (2002) point out that IPO short–run underpricing can neither be explained by the fundamental valuation approach nor the risk–return asset pricing approach. If it could be explained in a risk–return setting that the extremely high initial returns are the result of the investors requiring higher returns for extra risks associated with new issues, then similar returns should also be observed on the second trading day as the investors who buy IPO shares on the first trading day bear the same risk. However, such a pattern is not evident and underpricing exclusively describes the extreme premium from the offer price to the closing price of the first trading day. Therefore, Ritter & Welch (2002) emphasize that the key to solve the underpricing 'mystery' is to focus on the pre–listing pricing process of the new issues.

Up to the present, the IPO literature has been quite established with abundant theories and models explaining the underpricing anomaly as well as empirical studies supporting those theories. As we mentioned earlier, we can generally divide the underpricing theories into two categories: the classic theories, and the behaviour arguments. The classic theories are mainly based on the pricing process, while the behavioural arguments focus more on the IPO participators' behaviours. However, we need to be aware that there is also overlap between these two categories. There are also studies investigating IPO underpricing from slightly different angles that cannot be classified into any of those two mainstream categories. These studies often place a focus on the IPO pricing and/or allocation processes.

2.3.1 Information Asymmetry Theory

The information–asymmetry based theories, sometimes referred to as ‘classic’ or ‘rational’ theories, are developed on the basis of the assumption that there exists a certain level of information asymmetry between different parties involved in an IPO event. Although there are quite a few parties involved in an IPO, the IPO outcome is mainly decided by three parties, namely issuers, underwriters, and investors. The classic theories assume that one of these three parties has superior information to the others about the valuation of the issuing company and underpricing is an inevitable cost resulting from the information asymmetry. In Baron's (1982) early attempt, we already see the assumption that the underwriters have more information than the issuer. It is Rock (1986) who systematically forms the information asymmetry theory in his PhD dissertation for the first time.

Information asymmetry theory is still one of the most widely recognized explanations for IPO underpricing. Rock (1986) develops the theory based on the analysis of the demand-price relation. He assumes that there is a group of investors in the market which has better information about the IPO companies’ value than the other investors, underwriters and the issuers themselves. He also assumes the existence of quantity rationing in the IPO share allocation. The better-informed investors will profit from purchasing underpriced shares by knowing whether the new issues’ prices are set lower or higher than the market value. At the same time, the demand for the underpriced offerings will be pushed up by the informed investors as they know for certain that they can profit. Once the demand is high, the rationing will happen. The uninformed investors who do not have such an information advantage will be forced into a situation where they cannot get the underpriced shares and are more likely to be rationed with the overpriced shares. As a result of this bias, the uninformed investors will become unwilling to participate in the primary market. As the issuers need uninformed investors’ participation to guarantee the proceeds that their IPOs can realize, issuers will deliberately

lower the offer price to a certain level to compensate for their disadvantages due to information asymmetry. Rock (1986) believes in the existence of a better-informed group of investors for two reasons: first, in order to prove its quality to the public, a firm has to give up its advantages in obtaining and keeping some secret information; second, the issuer and its underwriters' information cannot win over the pooled talent of all the investors in the market. Even though Rock (1986) bases this model on 'firm commitment' IPOs, it is still effective when it is extended to the 'best effort' IPOs. In short, the offer prices are intentionally set at a discount by issuers and underwriters in order to attract the uniformed investors, a consequence of the information asymmetry between the issuers and some investors.

2.3.2 Winner's Curse Theory

Rock's (1986) work has implications for Beatty & Ritter (1986) who have developed one of the most prolonged explanations for IPO underpricing–winner's curse theory. The 'Winner's Curse' theory is developed upon two crucial conditions. First, there exists the ex-ante uncertainty which refers to the fact that the investors cannot be certain about the true values of the issuing companies even though the IPOs are averagely underpriced. This is due to the fact that some IPOs will actually suffer a decrease in the price by the end of the first trading day. The second essential condition is that there exists one of the most typical institutional features - quantity rationing. Following Rock (1986) who argues that the demand for the underpriced new issues will be driven up by the informed investors' subscriptions, Beatty and Ritter (1986) further point out that the underwriters respond to the excessive demand with quantity rationing because the offering price cannot be adjusted according to investors' demand once it is set. Therefore, knowing the existence of the average underpricing does not guarantee that the investors will profit from it. Beatty and Ritter (1986) conclude that the bias between informed and uniformed investors will eventually create the 'winner's curse' risk. They define the 'winner's curse' risk as if an investor is allocated with the number of shares that he has

subscribed to, he will be suspicious that those shares allocated to him are mispriced and unwanted by other investors. Therefore he will expect the initial returns of those shares that he has received be lower than the average initial return in the market (Beatty & Ritter 1986). In order to lower or avoid the 'winner's curse' risk, the uninformed investors will only submit subscriptions when the offering prices are underpriced enough to compensate for their uncertainty about the true value of the IPO shares. This implies a positive relationship between the underpricing of new shares and the ex-ante uncertainty about the issuing company's value. By using a sample of 1028 IPOs in the U.S. market from 1977 to 1982, Beatty and Ritter (1986) empirically test this potential relationship. In order to protect their business advantages and secrets, the issuing firms do not want to uncover too much specific information about how they are going to spend the proceeds that they raise from the IPOs. However, the SEC will require a certain amount of information about the use of proceeds to be revealed by the issuing company if the SEC is not so convinced about its stability and quality. This implies that the more information about the use of proceeds revealed in the IPO prospectus, the more uncertainty there is surrounding the company. Therefore, Beatty and Ritter (1986) use the number of the uses of proceeds reported in the prospectus plus one as a measure of the ex-ante uncertainty. In addition, according to the empirical evidence that small firms are harder to regulate than large firms, they also use the gross proceeds raised in the IPO as a second measure of the uncertainty, which has later become the most commonly used measure of information asymmetry. They find a positive relationship between the initial returns and the number of uses of the proceeds as well as a negative relationship between the initial returns and the gross proceeds, supporting their argument that the level of underpricing is positively related to the level of the ex-ante uncertainty about the issuing company. Beatty and Ritter (1986) further conjecture that it is the underwriters who are constantly balancing the underpricing equilibrium. They argue that the issuing companies have no motivation to leave money on the table to please the investors as the

IPO is a one-time event. It is actually the underwriters who have strong incentives to please the investors in order to achieve and maintain their reputation in future IPO games. In other words, if the IPO underwriters could not underprice the offerings to the right level, either too high or too low, to reflect the degree of the ex-ante uncertainty, its reputation will be damaged. As a result, the underwriters would experience either a decrease in the underwriting fees or an increase in the distribution costs. In this sense, underpricing can also be regarded as a strategy used by the underwriters to avoid such situations. Beatty and Ritter (1986) create two time periods and regress the change in the market shares of each underwriter in the second time-period on the extent of mispricing of the new issues underwritten by them in the first period. Although the results are not strongly significant, they do reflect that the investment bankers who have mispriced the new issues will suffer a decrease in their market shares following the IPO. This paper also presents an initial attempt to investigate the relationship between underpricing of IPOs and underwriters' reputation which has since stimulated a lot of studies.

2.3.3 Information Extraction Theory

Following Beaty and Ritter (1986) who demonstrate the important role of underwriters in the IPO events, Benveniste and Spindt (1989) develop the information extraction theory, which is also essentially based on information asymmetry. It is slightly different from previous information–asymmetry based studies in that it focuses more on the underwriting process of an IPO. More specifically, they observe the 'bookbuilding' practice of the IPO underwriting process. Hence the information extraction theory is sometimes referred as 'bookbuilding theory'. Bookbuilding is a very commonly-used practice by the underwriters in the presale market of IPOs. During the bookbuilding process the underwriters give a price range to potential investors instead of a fixed price. Benveniste and Spindt (1989) argue that as underwriters are not the best informed party about the true value of the issuing company they will try to extract as much useful information from the informed investors as they can during

the presale market and adjust the offer price and share allocation accordingly. Benveniste and Spindt (1989) assume the presale market as a single-price auction giving a price range, in which the underwriters receive the indications of interests in the IPO shares from potential investors. The indications are reflected in the unofficial 'bidding' prices and quantities. With the indications of the prices that the investors will be willing to pay and their demand for the new issues, the underwriters will have a better idea of the market value of the new shares. Eventually, the offer prices will be set accordingly. In addition, in the auction process, the underwriters presumably prefer the 'good' information revelation from investors, which will have a positive impact on the valuation, rather than the bad information. However, as Benveniste and Spindt (1989) point out, the difficulty in this 'price discovery' process is that the informed investors are unwilling to share their superior information if they can profit from it. As a result, they might not give the 'real' price in their mind during the auction. In order to induce the investors to reveal good quality information in the presale market, underwriters will strategically take advantage of the fact that they run a repeated IPO business and they can easily form a coalition with those investors, who are willing to share their information, by giving them priority in the allocations in future IPOs. The implicitness of this coalition game is that even though investors might lose one IPO investment, they will always benefit from being constantly included by the underwriters in future IPO events. Those who are unwilling to share information will be excluded from the coalition and lose the present value of priorities in participating future IPOs. In this process, underwriters will then deliberately underprice the new shares in general to compensate those investors for giving up their information advantages. However, in terms of the issuers, the extent of underpricing will be relatively reduced and the efficiency of financing will be increased by the underwriters' information extraction activities. In general, the underwriters use underpricing as a strategy to create a 'win–win' outcome for the issuers and investors, which is also beneficial to their own business. In this sense, the information extraction

theory treats the underwriters as information intermediaries that can enhance the efficiency in the IPO valuation. This is one of the most empirically supported theories on IPO underpricing and particularly relevant to the hypothesis development in the first study, which will be elaborated on in Chapter 3.

Using IPO as a setting, Chemmanur and Fulghieri (1994) actually generalize the role of underwriters as intermediaries or information producers in the equity market. They argue that, not just in an IPO event but in all equity selling events, underwriters set standards to evaluate the issuers and report the valuation back to investors. There exist three fundamentals in the intermediary business. First, setting very stringent standards could minimise the uncertainty about the valuation, but is costly. Second, these standards as well as the efforts that the underwriters put in are unobservable. What observable is the underwriters' past performance. Third, underwriters have a more frequent interaction with the investors than the issuers, meaning their past performance matters more to the investors and their own future market value. With the above fundamentals, underwriters face a dynamic trade-off within which, Chemmanur and Fulghieri (1994, p. 58) conclude, that "the evaluation standard set by investment banks, their reputations, valuation of firms by investors, investment banking fees, and entrepreneurs' choice between underwritten and direct sales of equity emerge endogenously."

2.3.4 Partial Adjustment

The information extraction process in Benveniste and Spindt (1989) suggests that the investors are motivated to reveal good quality information about the IPO company with a favoured allocation and underpriced shares, indicating a partial adjustment phenomenon which was first defined by Ibbotson et al. (1988). Instead of setting an offer price to fully reflect its fair value, Ibbotson et al. (1988) find that the initial returns for those IPOs with the final offer price adjusted upward above its initial file range are higher and they call this phenomenon

'partial adjustment'. Among many studies with findings supporting Benveniste and Spindt (1989), Hanley (1993) presents the most famous empirical study. With a sample of 1430 IPOs from 1983 to 1987, she finds an average initial return of 20.7% for IPOs with a final offer price above the file range, 10% for those with a final offer price within the file range and 0.6% for those priced below the file range. She finds that the extent of the change between the final offer price and the midpoint price of the file range has a positive effect on the level of underpricing, supporting the partial adjustment phenomenon indicated by Benveniste and Spindt (1989). On top of that, she finds that underwriters prefer to reward the investors who share their useful information in the presale events with a smaller number of heavily underpriced shares rather than a large number of slightly underpriced shares. She also finds that the price revisions are more likely to happen if the IPOs are managed by more experienced underwriters, as more experienced underwriters can extract more good quality information due to their stronger coalitions with the regular investors. This partial adjustment phenomenon is widely documented in international studies as well. For example, Minardi et al. (2015) find that the partial adjustment is one of the significant determinants of the IPO underpricing in Brazil.

2.3.5 Signalling Model

The signalling model, concurrently proposed by Allen and Faulhaber (1989), Grinblatt and Hwang (1989) and Welch (1989), assumes that the insiders/issuers have better information than the outsiders/investors. As a result, rational investors are concerned about the 'lemon' problem that companies with average IPO offer prices actually have below-average quality. In order to differentiate themselves from the 'bad quality' companies, the 'good' companies will deliberately underprice IPO shares in order to send a signal of 'good quality' to the public. Only the 'good' firms can afford this initial cost of underpricing because they know that the cost will be recouped in the future seasoned equity offerings (SEOs) after their good performance is known to the public, implying that more underpriced IPO companies will carry out the SEOs

sooner and bigger. By signalling the 'good' quality with underpricing, the information asymmetry in the future SEOs is also decreased. The most significant difference between the signalling model and the other information-asymmetry-based theories, as Allen and Faulhaber (1989) point out, is that the signalling model does not emphasize the roles of underwriters in the IPO events. Among all the other possible methods of signalling, underpricing is favoured because it is the least costly with no monitoring required. In other words, the investors are the direct recipients of this signal, making it the most efficient method. Although the 'low' quality firms could underprice their IPO shares on purpose in order to pretend to be a 'good' firm, the increased costs of the deceptive signals stop them from doing so. Welch (1989) points out that the imitation costs also include the costs that the 'bad' firms must pay to imitate the real operation activities of the 'good' firms other than the signalling costs caused by underpricing. With a high probability that the imitation behaviour would be discovered by the investors during the period between the IPO and the first SEO, the 'bad' firms might not be able to recoup the costs in future SEOs. Therefore, they would rather stay as 'low' quality firms in the IPO events with little or no underpricing.

2.3.6 Empirical Evidence on Classic Theories

The above classic theories have been raised and supported by a large number of empirical studies not only in the U.S. but also across the world, and we are only able to name a few here. The size of the issuing company, often measured by the IPO offering size or IPO proceeds, is the most commonly used proxy for the level of information asymmetry of or uncertainty about the true value of the company. A lot of empirical studies have presented evidence that the bigger the company, the less asymmetric information there will be, leading to lower underpricing. Firm age is also a popular measure of the information asymmetry in that the older the company, the more information there will be available, hence less underpricing (Megginson and Weiss, 1991, Wasserfallen and Wittleder, 1994, Ljungqvist, 1997, Hameed

and Lim, 1998, Mok and Hui, 1998, Jog and McConomy, 2003, Kim et al., 1993, Guo et al., 2006, Arthurs et al., 2008, Dolvin and Jordan, 2008, Derrien, 2005). Some other characteristics are also found to be related to the uncertainty about the IPO valuation. For example, the longer the gap is between the issuing and listing dates of IPOs, the more uncertainty there will be, resulting in higher underpricing (Mok and Hui, 1998). According to Benveniste and Spindt (1989), bookbuilding is the most effective method to produce information during the IPO process. Therefore, IPOs with bookbuilding methods are found to experience lower underpricing (Hameed and Lim, 1998, Hill and Wilson, 2006). Technology companies are often considered to have more uncertainty surrounding the valuation and are associated with higher initial returns than other industries (Loughran and Ritter, 2004, Arthurs et al., 2008, Su and Bangassa, 2011, Dolvin and Jordan, 2008).

Among the classic theories mentioned above, the signalling model has probably produced the most inconclusive empirical results. Slovin et al. (1994) find that companies with higher underpricing receive a less negative price response to their following SEO, supporting the signalling model. However, the underpricing cost is not fully recouped as the signalling model suggests. Although Jegadeesh (1993) finds that more underpriced companies tend to issue the SEOs sooner and that their first SEOs tend to be bigger in size, the economic significance is weak. Focusing on the total cash flows, Spiess and Pettway (1997) find no support for the signalling model and suggest that the total proceeds raised in a more underpriced IPO and its first following SEO are not bigger than those less underpriced issuing companies.

In general, there is a trend in the literature that the information-asymmetry-based theories are built on top of classic finance theories under a western or developed market regime and supported with evidences drawn from western data. When it comes to developing countries where the regime is considerably different, it is natural to expect some extent of distortions in

the efficiency of such classic theories. In fact, with a dynamic selection of datasets, this thesis presents evidence that information-asymmetry-based theories only play a weak role in the explanation of the extreme underpricing in emerging markets, especially when their special systems are taken into consideration.

2.3.7 Underwriters

Underwriters are arguably the most important party in an IPO event, alongside issuers and investors. To recall, Beaty and Ritter (1986) argue that it is the underwriters who balance the equilibrium of underpricing in order to maintain their reputation for future IPO business. Benveniste and Spindt (1989) later propose that underwriters act as an information producer in order to minimise the uncertainty about the IPO valuation by forming and maintaining a coalition with regular investors. All these arguments indicate a negative relationship between the underwriters' reputation and the level of IPO underpricing.

As Benveniste and Spindt (1989) imply, the pricing performance of the underwriters in the IPO events is the observable quality measure which, as proposed by Beaty and Ritter (1986), affects their future business. James (1992) confirms this implication with empirical evidence that underwriters who have settled a less-than-optimal offer price would be punished with decreasing subsequent market shares. To follow Beaty and Ritter (1986), Nanda and Youngkeol (1997) examine in detail how the pricing of the IPO shares is associated with the underwriters' reputational capital. Specifically, they find that overpricing is indicative of a decreasing market share of the underwriters. However, for moderately underpriced IPOs, their underwriters are rewarded with an increase in the subsequent market share. However, this reputational gain shrinks with the increasing level of underpricing. This is consistent with the underpricing equilibrium argument by Beaty and Ritter (1986) and the information producer argument by Benveniste and Spindt (1989). This interesting result indicates that a certain level of

underpricing might just be inevitable, like the direct costs. In the case where the IPO is jointly managed, Nanda and Youngkeol (1997) find that it is the lead-underwriter who primarily bears the punishment.

Carter and Manaster (1990) have constructed one of the most widely used measurements of the underwriters' reputation based on the U.S. market, allowing the following empirical studies to be able to test this relationship. The Carter-Manaster measure of the underwriter prestige ranking is based on the pecking order shown in the 'tombstone' announcements which is a list of the pending IPOs. In the announcement, there is a passage presenting the underwriting syndicate in a hierarchy with the lead and co-lead underwriters listed in the top section or section A. The other underwriters follow an order where the more prestigious ones are listed in a higher section with more underwriting shares, i.e. underwriters in section B have more prestige and underwrite more shares than those in section C. An integer of 0 to 9 is assigned to each underwriter with the ones in the top (lead or co-lead underwriters) assigned 9, those in section B assigned 8 and so on. The result of the first 'tombstone' announcement is used as a referencing point and the ranking is adjusted every time after reviewing another 'tombstone' announcement. After all the 'tombstone' announcements are reviewed, it eventually produces a ranking of 0 to 9 with rank 9 being the underwriters with the highest reputation and rank 0 being underwriters with the lowest reputation. By using this measure, they find that IPOs underwritten by more prestigious underwriters indeed have lower underpricing.

Since the 'tombstone' announcements are not always applicable to other countries, the market-share measure of the underwriters' reputation proposed by Megginson and Weiss (1991) has become equally popular. Megginson and Weiss (1991) assume that the quality of an underwriter is presented by the total market share by this underwriter. In other words, during a

sample period, the underwriters' quality is ranked by the percentage of the IPO size (proceeds) brought to the market by each underwriter of the total size of all the IPOs during this period. The higher the market share, the more prestige the underwriter has. With this measure, Megginson and Weiss (1991) also find a negative relationship between the underwriter quality and the level of underpricing.

Carter et al. (1998) re-examine this relationship with an updated dataset. Consistent with previous studies, they find that IPOs brought to the market by underwriters with a better reputation result in a lower level of underpricing. Carter et al. (1998) also compare the Carter-Manaster measure of the underwriters' reputation with other measures. Although all the other measures have returned similar results, they find that the Carter-Manaster measure explains the greatest amount of the variation. By using the Carter-Manaster measure, Guo et al. (2006) also record a negative relationship between the underwriters' reputation and the level of underpricing.

Aside from the empirical findings supporting a negative impact of the underwriters' reputation on the level of underpricing, a reverse relationship has also been documented in a number of studies. Beaty and Welch (1996) are among the first to detect the reversed relationship where the IPOs managed by more reputable underwriters actually experience more underpricing, which supports the agency theory by Baron (1982). Based on a sample of 1475 IPOs from 1988 to 1995, Logue et al. (2002) find no significant relationship between the underwriters' ranking, using the Carter-Manaster measure, and the level of underpricing. Instead, pre-market activities by the underwriters, such as the partial adjustment, are the main determinants of the IPO initial returns. Loughran and Ritter (2004) provide mixed results depending on the sample periods. They divide the sample period into four sub-periods: 1980s, 1990s, the internet bubble period (1999-2000) and the post-bubble period (2001-2003). They

find that the negative relationship between the underwriters' reputation and the level of underpricing was reversed in the 1990s and the internet bubble period. They argue that the reverse is likely due to the change of the policy of individual investment banks rather than the shifts in market shares.

An interesting study by Gondat-Larralde and James (2008), which holds a neutral opinion on the role of underwriters, argues that the underpricing is simply a result of how the investment banks run the business. As better-informed investors can avoid the overpriced shares (which is called a 'lemon dodge'), there is a downside risk of the initial returns. They assume that, with an aim to maximize the offer price and avoid the downside risk, the underwriters will form a coalition with the investors in order to stop the investors' lemon-dodging behaviour. Specially, they 'punish' the lemon-dodging investors by excluding them from future IPO investment opportunities and 'reward' the investors who are willing to bear with the downside risk by involving them in future IPOs and guaranteeing a profit on average with block-booking. Therefore, they argue that the offer price is set by the underwriters to equalize the overall downside risk and the average coalition benefits.

Although whether the impact is positive or negative remains inconclusive, following abundant studies, it has now become evident to us that underwriters play a significant role in the outcomes of U.S. IPOs, regardless of the mechanisms. However, when it comes to international studies, the role of underwriters remains an open question. For example, Kim et al. (1993) find the underpricing of South Korean IPOs, between 1988 and 1990, is negatively related to the underwriters' reputation, measured by the market share. Kirkulak and Davis (2005) find that, in Japan, the impact of underwriters' reputation on the level of underpricing depends on the demand for IPOs. When the demand is low (high), there is a negative (positive) relationship between the underwriters' reputation and the level of underpricing. Consistent with

the agency theories, Dimovski and Brooks (2004) find that IPOs which employ underwriters actually leave more money on the table than those which do not employ underwriters, with a sample of 358 Australian IPOs between 1994 and 1999. To follow up this study, Dimovski et al. (2011) examine the Australian IPOs with an extended sample period from 1994 to 2004. By using the deviations of the underwriters' reputation measure proposed by Megginson and Weiss (1991), they find further evidence that the underpricing is higher for IPOs involving more prestigious underwriters. In emerging markets like China, Su and Bangassa (2011) find that underwriters' reputation has no impact on the outcomes of IPOs.

While the previous literature has a focus on the reputational value of the underwriters, other aspects of the underwriters have also been investigated. Ellis et al. (2000) reveal the dark side of the underwriting business. They find that the lead underwriters are usually the dominant market makers and their post-IPO trading profits are positively related to the level of underpricing, implying an incentive for the underwriters to push for higher underpricing. A recent study by Boeh and Dunbar (2016) investigates how an underwriter's deal pipeline affects the IPO pricing decisions. For each IPO, they construct different measures for the pipelines of the bookrunners of this IPO, i.e. the change in the total capital in the pipeline managed by this bookrunner in a window between filling and issuance dates. In general, their results tally with the agency theories that underwriters push for higher initial returns by using shorter pipelines. They also find that, with both the Carter-Manaster and market-share measures, underwriters' reputation positively affects the level of underpricing.

2.3.8 Certification Role of the Venture Capitalists

As another group of regular participants other than underwriters, the involvement of venture capitalists in the IPOs has also attracted plenty of research interest. Based on a sample of 433 IPOs between 1978 and 1987, Barry et al. (1990) conduct the first exploratory analysis

of the role of the venture capitalists in the IPO event. They argue that venture capitalists actively engage in the management of the company in which they take considerable equity positions. This monitoring service provided by the venture capitalists sends out a good signal regarding the company's quality to the investors at the time of IPOs. Therefore, the investors will require a lower level of underpricing. They further argue that venture capitalists' 'goodwill' in improving the company is supported by the fact that they increase their equity holdings after the IPOs. The first systematic theory, as well as empirical test, comes from Megginson and Weiss (1991) where they follow the formal certificate hypothesis by Booth and Smith (1986) and find that venture capitalists play a certification role in the IPOs. Megginson and Weiss (1991) argue that, as major investors of the company before going public, the existence of venture capitalists in an IPO company certifies that the IPO offer price reveals all the relevant information. By matching a sample of venture-backed IPOs to a sample of non-venture-backed IPOs, they find that the venture-backed IPOs experience significantly lower underpricing. They reinforce this argument with findings that venture capitalists attract more prestigious underwriters and auditors to the issuing company. Similarly to Barry et al. (1990), they also find that venture capitalists tend to retain significant amounts of holdings after the issuance, enhancing the credibility of their certification roles. Arthurs et al. (2008) study a more complicated agency environment where there are conflicts of interests between different agencies. The main conflicts in their setting exist between the venture capitalists and investment banks when the venture capitalists sitting on the managerial board, representing their own interests, will try their best to avoid leaving money on the table; meanwhile the investment banks who need to maintain a long-term relationship with their institutional investors, therefore representing the investors' interests, will push for a higher underpricing. They find an inverse relationship between the venture capitalists' ownership in the IPO company and the level of underpricing, which is also consistent with Megginson and Weiss (1991). More importantly,

they find that when having ties with the underwriters before the IPOs, venture capitalists' negative effect on the level of underpricing is weakened or even diminished. The strength of the certification role, however, depends on the maturity of the venture capitalists according to Gompers (1996) who finds that IPOs backed by young venture capitalists experience higher underpricing than those backed by more mature venture capitalists.

However, the reverse relationship between the presence of venture capitalists and the level of underpricing has also been well documented in the literature. With a sample period over 19 years (1986-2004), Dolvin and Jordan (2008) find no significant relationship between the venture capital status and IPO underpricing. However, mixed results start to appear when the sample period is divided. For IPOs between 1990 and 1998, the venture-backed IPOs have significantly lower underpricing than the non-venture-backed ones. Between 1999 and 2000, the venture-backed IPOs actually experience more underpricing than the non-venture-backed ones. The positive effect of the venture capital status on the level of underpricing is also found in Guo et al. (2006), Boeh and Dunbar (2016) and Liu and Ritter (2011). The "analyst-lust theory" by Liu and Ritter (2011) gives a possible explanation for this positive relationship. They argue that because the venture capitalists are more interested in the market price on the day when the shares are distributed to the limited shareholders, which usually happens after the lock-up periods, they have a great desire to attract the all-star analysts' coverage which can affect that price, leading to a higher underpricing. In general, the role of venture capitalists in IPO outcomes remain inconclusive and need to be further explored.

2.4 Behavioural Arguments on IPO Underpricing

When classic theories seem inadequate to fully explain underpricing, academics turn to the behavioural approach. If underwriters intentionally underprice shares to serve the interests of their long-term clients (usually institutional investors) rather than the issuers that they are

representing, then the most obvious behavioural puzzle is why the issuers do not get upset about leaving so much money on the table. The first behavioural model employed to answer this question is proposed by Loughran and Ritter (2002) which is based on the famous Prospect Theory by Kahneman and Tversky (1979). Based on the value function, the Prospect Theory suggests that, when facing related outcomes, an individual can choose to either integrate or segregate them, a result of 'mental accounting'. When there are two value gains, the individual tends to treat them as two separated 'wins'. When there are two value losses, the individual prefers to integrate the losses so they only experience one loss rather than two. When there is one gain and one loss, how the outcomes are processed depends on the absolute value gain or loss. When the value gain is bigger than the loss, the individual will integrate the outcomes and generally be happy about the absolute value gain, which applies to the IPO underpricing situation. For the issuers, the value of their holdings increases substantially after the first day of trading compared to the expected valuation based on the initial file range of the offer price. Compared to the value gain, the diluted wealth, or value loss, due to the underpricing seems neglectable. Therefore, the issuers do not get upset with the underpricing. To take advantage of this, Loughran and Ritter (2002) point out that the underwriters will only partially adjust the offer price. They find evidence that when the market performs well before the IPOs, measured by the three-month pre-IPO market return, the underwriters only adjust the price to a very limited extent and the underpricing is higher. Lowry and Schwert (2004) also find a significant relationship between the pre-IPO market return and the level of underpricing, supporting the argument by Loughran and Ritter (2002) that the public information is only partially adjusted. However, the economic significance is so small that they claim the public information is almost fully incorporated into the offer price. Most studies, however, record both statistically and economically significant relationships supporting Loughran and Ritter (2002) (Boeh and

Dunbar, 2016, Derrien and Womack, 2003, Derrien, 2005, Hill and Wilson, 2006, Ljungqvist, 1997, Su and Bangassa, 2011).

Another behavioural approach to explain the underpricing anomaly was attempted by Ljungqvist et al. (2006). They assume that, apart from rational investors, there are 'sentiment' investors who have optimistic views about the valuation of the IPO companies. In order to maximise the overvaluation driven by the demand of the exuberant investors, the issuers and underwriters adopt an optimal strategy which is to sell the shares to the institutional investors who participate in IPO investments regularly (Ljungqvist et al. (2006) refer them as 'regulars'). By holding the stocks in their inventory and releasing the stocks to the market/sentiment investors gradually, 'regulars' help to stabilize the price which would otherwise be depressed by a large number of shares flooding the market. The regulars, however, bear the risk that the behaviour of the sentiment investors is unpredictable and the excessive demand could die down at any minute. Therefore, issuers agree to a certain level of underpricing to compensate 'regulars' for this risk. The issuers still benefit from a relatively higher offer price driven by the exuberant investors. Based on a sample of French IPOs between 1999 and 2000, Derrien (2005) finds supporting evidence for the investor sentiment arguments. He finds that the individual investors are usually the sentiment investors whose demand significantly affects the initial returns of IPOs. With findings consistent with Benveniste and Spindt (1989), he concludes that the level of underpricing is a product of both the information extraction process before the IPO and the sentiment investors' exuberant demand after the IPO.

With a sample of Chinese IPOs, Chang et al. (2008) find evidence supporting the behavioural argument. By dividing the initial return into two parts from the opening price of the first trading day, they find that the aftermarket initial return, the difference between the closing and the opening prices of the first trading day, is significantly driven by 'sentiment'

investor demand. By using the same method to divide the initial returns into pre- and after-market initial returns, Gao (2010) finds similar results that the excessive after-market initial return is largely driven by 'sentiment' investor demand while he finds little explanatory power in the classic theories on the extreme underpricing in China, suggesting that, other than classic theories, behavioural arguments are more appropriate in emerging markets. In this thesis, the comparison between the classic and behavioural arguments is carried through three studies with different samples. When the same method is applied to the U.S. sample, Reber and Vencappa (2016) find that although the after-market initial return is related to the demand on the first trading day, it only accounts for a small part of the overall underpricing. The pre-market deliberate underpricing is the main component of the overall underpricing and it is still largely explained by the information-asymmetry-based classic theories.

2.5 Other Theories and Empirical Studies of Underpricing

In this section, we present a few other informative explanations for IPO underpricing other than the mainstream studies discussed above.

Booth and Chua (1996) present the first study on the relationship between the issuers' desire for ownership dispersion and IPO underpricing. They argue that underpricing is used by the issuers to attract oversubscription which in turn creates dispersed ownership, resulting in a lower required return. Underpricing is a price the issuers pay to compensate for the investors' bearing more information cost increased by a broader initial ownership. Similarly, Brennan and Franks (1997) propose that the underpricing and rationing practice is used by the inside owners to retain control and to avoid block holdings/purchase in the offering. Supporting evidence is found on a sample of UK IPOs between 1986 and 1989. Boulton et al. (2010) extend this to a cross-country study where they examine how the country-level governance affects the underpricing. They find that in countries where the legal system gives more protection to

outside investors than insiders, the issuers tend to underprice more in order to create a more dispersed ownership and retain more control. However, in contrast to Booth and Chua (1996) and Brennan and Franks (1997), when the corporate governance associated with the ownership structure is taken into account, it has been recorded that the institutional investors are favoured in the IPO. Stoughton and Zechner (1998) justify the IPO underpricing with a 'moral hazard' argument. Inspired by the literature which documents that an optimal institutional ownership can maximise a firm's value by offering better external monitoring, they argue that underpricing and rationing allow the underwriters, representing the issuers, to differentiate the classes of investors in order to favour the institutional investors in the offering as they offer better external monitoring management.

Although underwriters are considered the most important practitioners in the IPO events, the auditing and accounting parts of an IPO event, like any other investment and finance activities, is not dismissible. Similar to the studies on the underwriters' reputation, Beaty (1989) finds that the auditors' reputation is negatively related to the level of underpricing. As underpricing damages the issuers' wealth, the issuers will then try to disclose low ex-ante uncertainty information, indicating a possibility that some issuers might misrepresent. Beaty (1989) argues that auditing is one way to attest to the information quality, and the information disclosed in the reports is more reliable if they are audited by reputable auditors as they have more reputational capital to protect. As a result, the underpricing is reduced. The most significant change in the financial accounting procedures around the world goes to the mandatory adoption of International Financial Reporting Standards (IFRS) around 2005. Hong et al. (2014) look at how the financial reporting procedure itself could affect IPO underpricing. More specifically, with a sample across 20 countries, they find that the adoption of the IFRS around 2005 reduced the IPO underpricing, on average, due to the enhanced quality of the reported financial information.

Section 11 of the Securities Act of 1933 protects the investors from any damages caused by neglected or falsely disclosed information in the U.S. Specifically, the investors can sue any party that has signed the financial reports. Based on this fact, Tinic (1988) argues that underpricing is an efficient way to insure against possible legal liabilities and, especially, the damages to the reputation of the issuers and underwriters.

While the majority of the preceding theories are developed in the U.S. market, the explanatory power of these theories varies when they are applied to the emerging markets. As one of the biggest economic bodies in the world, China is a representative emerging market with its unique financial environment that has possibly attracted the greatest amount of research interest. Mok and Hui (1998) record a wildly high underpricing of 287% and find that the state-ownership, i.e. owned by the Chinese Government, explains a significant amount of this underpricing. Chan et al. (2004) record an underpricing of 178% between 1993 and 1998. They find that the classic theories only account for a very limited amount of underpricing and the relationship between the level of underpricing and the state-ownership is also weak. Fan et al. (2007) also document a positive relationship between the state-ownership and the level of underpricing in China. However, they find that IPO companies with politically connected CEOs actually experience less underpricing. Although this result is only weakly significant, it somewhat supports the Signalling Model that companies free from government intervention, which is otherwise brought in by the politically connected CEOs, have incentives to underprice more in order to signal this good quality to the outside investors. Tian (2011) records 247% underpricing on average for Chinese IPOs from 1992 to 2004. She finds evidence that government intervention is indeed a 'bad' signal where interventions like pricing and share supply regulations are significant drivers of the extremely high underpricing. An elaborated review of the IPO literature in China is presented in Chapter 4.

2.6 Real Estate IPOs

In previous sections, we have focused on the studies on the IPO performance of domestic industrial companies which excludes the financial institutions and real estate companies. In this section, we review the literature on real estate IPOs and in the next section we discuss the limited research on the international or cross-country IPOs.

2.6.1 Special Characteristics of Real Estate Companies

Real estate companies, especially real estate investment trusts (hereafter REITs), are often excluded from the general IPO studies because of their special structures of operation and management. Apart from holding real properties as the underlying assets, some of the unique features of REITs include their tax-exempt status and dividend pay-out policies. Tax-exempt status means that they have no advantage to issue debt. In other words, equity issuing is relatively cheaper for REITs. REITs are required to pay out a certain amount of net income as dividends and this requirement is often set very high, i.e. the pay-out ratio is 95% in the U.S. and 90% in the UK. The tax-exempt status and the high dividend pay-out ratio indicate a strong need for REITs to raise capital externally.

2.6.2 Real Estate IPO Performance and Attempted Explanations

Unlike the industrial IPOs which are averagely underpriced, mixed first-day returns of REIT IPOs have been recorded. The pre-1990 studies in the U.S. record either overpriced or fair-priced REIT IPOs. Although most of the studies record significant underpricing of the post-1990 REIT IPOs, the average initial return is still abnormally low compared to that of the industrial IPOs. If the underpricing of industrial IPOs is a puzzle, Chan et al. (2013) call this abnormal behaviour of REIT IPOs a ‘puzzle within the puzzle’.

Wang et al. (1992) present the first study focusing on REIT IPOs and recording the overpricing phenomenon. Based on 87 U.S. REIT IPOs from 1971 to 1988, they observe an

average initial return of -2.82%. With a mix of 58 mortgage, equity and hybrid REITs, Below et al. (1995) find neither underpricing nor overpricing and claim that REIT IPOs are fairly priced. As the classic theories are based on the assumption of information asymmetry, they are unable to explain the negative initial returns. Wang et al. (1992) propose that the fund-like structure, the low involvement of institutional investors and the holdings of underlying real assets might be what distinguishes REITs IPO performance from industrial companies. In particular, they argue that REITs are more similar to mutual funds, at least in the 1980s, which generally have low levels of underpricing. REIT IPOs before 1990 were also heavily allocated to the individual investors who were usually uninformed investors. In the end, they argue that abnormal IPO performance may be due to the fact that REITs hold a substantial amount of real properties which have different risk-return profiles compared to common stocks.

We know that U.S. REITs went through several structural changes in the late 1980s. For example, the Tax Reform Act of 1986 eliminated the tax advantages of other real estate investments which has made REITs a preferred form of real estate investments. Also, the U.S. equity REITs have become more attractive to institutional investors due to the transformation to internal management in the late 1980s. By the 1990s, U.S. REITs become more like operating companies with a similar, if not higher, level of institutional involvement. With a sample including all the REITs between 1984 and 1995, Chan et al. (1998) find that the institutional involvement in REITs has not only hugely increased compared to that before 1990, but also exceeded that in other common stocks. To examine the microstructure of REITs, Glascock et al. (1998) find that when asset structure, share price, trading volume, and return variance are controlled for, REITs and common stocks have similar bid-ask spreads, suggesting that REITs are not necessarily less liquid than common stocks.

Following these changes in the U.S., the REITs IPO performance has also undergone change from being averagely overpriced to significantly underpriced. The market-adjusted average initial return of REIT IPOs between 1991 and 1994 is 3.6%, significantly above 0 (Ling and Ryngaert, 1997). With 123 REIT IPOs from 1982 to 2000, Akhigbe et al. (2004) find an underpricing of 4.28% with 73% of the sample IPOs returning positive initial returns. Hartzell et al. (2005) record an average initial return of 0.27% for 49 IPOs between 1980 and 1998, which is not significantly different from 0. However, they point out that this is simply due to the significant overpricing before and underpricing after 1990. With a longer sample period from 1980 to 1999 and more observations (197 REIT IPOs), Chen and Lu (2006) find 3% average underpricing on the full sample, 1.3% overpricing for pre-1990 IPOs and 4.3% underpricing for post-1990 IPOs. Similar findings are also recorded in Joel-Carbonell and Rottke (2009) who observe 4.3% underpricing for REIT IPOs between 1990 and 2007, and in Bairagi and Dimovski (2011) who observe an average initial return of 3.18% for 123 REIT IPOs from 1996 to 2010.

Ling and Ryngaert (1997) attribute this reversal to the increased uncertainty about IPO valuation due to the increased institutional involvement in the REITs market which leads to the Winner's Curse situation. However, this cannot explain the abnormally low underpricing of REIT IPOs compared to industrial ones.[6] Based on the fact that REITs depend on external funding, i.e. SEOs, more than other industries do, Ghosh et al. (2000) think REIT IPOs a more suitable lab for testing the signalling model. They pair the IPOs issued between 1992 and 1995 with their first SEOs and find results that generally support the signalling model which, if we recall, suggests that underpricing is used as a signal for good quality and that the cost will be recouped in the following SEOs. Specifically, Ghosh et al. (2000) find that more underpriced

[6] According to Table 1 in Ritter (2017), the average underpricing for U.S. industrial IPOs from 1991 to 1994 was above 10%.

REITs indeed issue their first SEOs sooner and their joint capital raised in the IPOs and the first SEOs is also higher, implying recognized good quality by the public. As the fund-like structure pre-1990 and the institutional involvement cannot account for the underpricing of REIT IPOs after the 1990s, the underlying property holding has naturally caught the research interest. Chan et al. (2001) adopt Hong Kong as a testing ground as the real estate companies there are actually operating companies that are just as attractive to the institutional investors as other industries. With a comparison analysis between 56 real estate and 343 non-real estate IPOs, they find that holding real properties does not differentiate the IPO performance of real estate companies from that of other industries. However, the real estate companies included in this study are not all exactly REITs, which have more strict definitions, making the inferences drawn from this sample very limited. Although no direct relationship between the real asset holding and the IPO valuation is found, the result is inconclusive to eliminate all the other indirect influences that the underlying assets might have on REIT IPO valuations. Hartzell et al. (2005) conduct a more specific study on the role of the underlying real estate assets in REIT IPOs based on the U.S. market. Although they do not determine the mechanism through which the effect is transmitted, overall they find that both the IPO volume in a period and the average initial return are affected by the conditions of the underlying real asset market, or in other words, the private real estate market. Specifically, they find that the demand for REITs is negatively related to and the private market performance is positively related to the initial returns.

Similar to the 'hot issue' market studies on industrial IPOs, Buttimer et al. (2005) investigate the REIT IPO waves around 1985, from 1993 to 1994 and from 1997 to 1998. With a sample period across 22 years, from 1980 to 2001, they find that the average initial return is not significantly different from 0 which is consistent with some of the previous studies. They argue that the Capital Demand Hypothesis is the most appropriate to explain the first two waves. When the economic environment of the REITs changes, their need for capital might be

increased, leading to a cluster of IPO issuance. The wave around 1985 was a response to the tax reform that was officially introduced in 1986. The increased demand for REITs in the early 1990s and the development of UPREIT triggered the second wave of IPO issuance between 1993 and 1994. However, the Capital Demand Hypothesis seems incapable of explaining the third wave as no significant economic changes have been identified around that time.

When it comes to other countries, Londerville (2002) finds small but significant underpricing based on just 13 Canadian REIT IPOs issued in 1998, which is similar to the U.S. market in the 1990s. Brounen and Eichholtz (2002) study the real estate IPO performance in the UK, France and Sweden with 54 property investment companies that went public during 1984 and 1999. The average underpricing is 2.55% across three countries, a figure that is largely contributed to by the significant underpricing in the UK which is 4.07%. Interestingly, they find that specialized companies, defined as holding more than 80% of the assets in one property type, have returned higher initial returns than diversified companies. This relationship and the rationale behind it has been further explored in one of the three empirical studies in this thesis (see Chapter 5). In Australia, Dimovski and Brooks (2006) also find low but significant underpricing for the property unit trust IPOs. They find that investor sentiment about the REITs market is particularly important to the IPO performance which is consistent with the behavioural arguments. They also find evidence supporting the Winner's Curse theory that institutional investors tend to receive more underpriced shares while individual investors tend to receive more overpriced shares. Ooi (2009) examines the REIT IPO performance from a different angle. He argues that the REIT structure makes it possible to pay higher management fees but this might affect the IPO valuation. He finds a positive relationship between the management fees of a REIT and its IPO initial returns. In other words, the market charges more for the IPO if the REIT is structured to pay out more management fees. Particularly, he finds that REITs with management fees above the industry median experience an average

underpricing of between 19.81% and 23.24% while the REITs with management fees below the industry median experience an average overpricing of between 3.86% and 4.12%. While there is no proper REIT market in China, Chinese real estate companies are usually both developers and investment companies. With a sample of 57 real estate companies that went public between 1992 and 2008, Wong et al. (2013a) find evidence supporting the signalling model that the 'good' companies signal their quality by choosing to be listed in Hong Kong, a more transparent and efficient market, instead of Mainland China. Real estate IPOs listed in Mainland China have a significant underpricing of 4.96% while those listed in Hong Kong have an average initial return that is not significantly different from 0, which is different from the study by Chan et al. (2001) which finds indifferent initial returns between real estate and industrial IPOs in Hong Kong.

Chan et al. (2013) conduct the first cross-country study on REIT IPOs using a sample of 370 REITs from 14 countries. Using univariate tests, they identify several factors related to REITs IPO performance. However, the univariate tests are not robust enough to disentangle the underlying dynamics of real estate IPO pricing. Furthermore, as all previous arguments seem to be insufficient to explain REIT IPO performance, they argue that the deadweight cost model proposed by Chan et al. (2009) is the most suitable explanation. This model does not require an assumption of information asymmetry and it actually works together with the fund-like structure and the underlying real asset holding arguments. The deadweight cost model argues that when underlying real estate assets can be sold with low costs in the private market at a price similar to the 'true' IPO price (the price that reflects the true value of the company), issuers should have less incentive to underprice shares to attract investors, if not taking the chance to overprice. Should the IPO fail, they could sell the properties efficiently in the private market. This results in low, or negative, initial returns of REIT IPOs. When U.S. REITs became more like operating companies in the late 1980s, the deadweight costs also increased and this may

explain the shift from negative to positive initial returns of REIT IPOs. However, the deadweight cost theory lacks empirical support.

We can see that U.S. REITs seem to be the only group which has experienced significant IPO overpricing pre-1990. Although the overall underpricing of real estate IPOs in most countries tends to be much lower than that of the industrial IPOs, it is still significant and offers a very attractive return to the IPO investors, as pointed out by Brounen and Eichholtz (2002). The literature on real estate IPOs remains incomplete and a lot of the empirical studies mentioned above suggest further investigations into the roles of the underlying real assets, a lead that the studies in Chapter 4 and Chapter 5 of this thesis follow and develop. Specifically, as the classic theories and other unique features of the real estate industry have failed to explain the performance of real estate IPOs, Chapter 4 and 5 further investigate the role that the underlying real assets of real estate companies play in the IPO valuation.

2.7 Cross-country IPOs

Another less-explored area in the IPO literature is the cross-country IPO variations. Cross-country studies are not new in corporate finance literature. However, it is not until quite recently that cross-country studies on IPOs have started to come to our attention. This stream of literature usually looks at how much the country-level institutional settings and the legal environment could account for the variation in IPO underpricing on top of the traditional firm- and issuing-level characteristics. Naturally, an overlap between these cross-country IPO studies and the law and finance literature is presented.

In general, the seminal papers in the law and finance literature by La Porta et al (1997, 1998, 2000, 2002) establish that the legal system in one country affects the development of its financial market and, at a micro level, affects the corporate finance and governance in this country, with significant economic consequences. In the law and finance literature, many

aspects of corporate finance and governance, such as ownership structure, external financing and dividend policy, have been re-examined under the legal institutions. As early as in the study by La Porta et al. (1997), they have identified a positive relationship between the number of IPOs and the quality of the legal environment, specifically, investors' rights, legal origin and legal protection.

The empirical studies on the relationship between the legal institutions and the well-known corporate finance anomaly—IPO underpricing—do not appear until after the 2010s. These studies argue that the legal system in one country could affect the ex-ante uncertainty about the IPO valuation on top of the firm- and issuing-related factors (Banerjee et al., 2011, Engelen and Essen, 2010, Hopp and Dreher, 2013). Specifically, they argue that issuing companies in a weaker legal environment would face higher uncertainty about their valuation than those in a stronger legal environment. In addition, a better legal system should also reduce the uncertainty surrounding the distribution of the issuing company's value during and after the IPO. For example, in a country where the legal protection of the investors is strong, the managers, insiders and big institutional investors will have less opportunities to 'bully' the individual investors. On the other hand, when the legal protection of investors, especially minority investors, is weak, the individual investors become reluctant to participate in the IPOs, thus more underpricing is needed. Overall, IPOs in a country with better legal institutions should experience less underpricing, which is supported by the empirical findings in these cross-country studies. Specifically, legal protection for investors, public enforcement, rule of law, corruption and English Common Law legal origin are found to be negatively related to the level of underpricing (Banerjee et al., 2011, Engelen and Essen, 2010, Hopp and Dreher, 2013).

When it comes to country-level institutional settings, the transformation that they have been undergoing due to the financial globalization process in the last few decades cannot be

neglected. This change has been examined specifically in the corporate finance context and the general argument has been raised that financial globalization is weakening the influences of country institutions on corporate finance activities. This strand of literature is particularly relevant to the development of the first study presented in Chapter 3 where a detailed review is also presented.

Chapter 3 : International Financial Integration and Cross-country IPO Underpricing

A cross-country study is presented in this chapter to identify a macroeconomic factor—international financial integration—which partly drives the IPO short-run performance, as well as its interactions with the country-level institutional settings.

3.1 Introduction

Even if the cross-country variation of IPO underpricing is a well-known phenomenon (Loughran et al., 1994, updated in 2015), the institutional settings of a country (hereafter 'country institutions') have become less important for the decision of going public domestically or abroad due to the increased integration of financial markets (Doidge et al., 2013). Initially, a growing stream of literature examined the impact of country institutions such as legal frameworks on the cross-country variation in IPO underpricing, after controlling for firm- and issuing-specific factors (Banerjee et al., 2011, Engelen and Essen, 2010, Hopp and Dreher, 2013). More recently, Doidge et al. (2013) and Caglio et al. (2016) follow the studies on the impacts of financial globalization on stock performance, corporate finance and governance, and show how it also positively supports the development of IPO markets (number and size of listings) as well as reducing the impacts of country institutions on IPO decisions. In this chapter, the study is to extend this literature by assessing how the increasing financial exposure to the global market at country level reduces IPO underpricing and weakens the impact that country institutions have on the cross-country variation of this phenomenon.

To our knowledge, this study represents the first attempt to link IPO underpricing with financial integration and the main contribution to the literature is threefold. First, we argue that international financial integration of one country directly increases both the importance and

efficiency of its financial intermediation process via tradable securities (including IPO underwriting), which in turn negatively impacts the level of IPO underpricing. The inverse relationship between the financial intermediation efficiency and the level of underpricing is empirically supported by extensive evidence following the information extraction theory by Benveniste and Spindt (1989) as elaborated in Chapter 2 (Carter et al., 1998, Carter and Manaster, 1990, Chemmanur and Fulghieri, 1994, Nanda and Youngkeol, 1997, Tinic, 1988). During the financial integration process, the focus of the banking business shifts away from the traditional depositary business to that of a financial intermediation via tradable securities, e.g. IPO and SEO underwriting services. An investment bank's market share of underwriting is affected by the efficiency of their previous underwriting performance measured by the level of underpricing as first proposed by Beaty and Ritter (1986). Meanwhile the international financial integration process reduces the competitive advantage of domestic banks through the presence of an increased number of foreign banks in domestic markets and increased opportunities for domestic companies to finance in foreign markets. To respond to the increased importance of the financial intermediation business, the overall quality of financial services will be improved through a spillover effect, where less competitive domestic players try to learn from foreign banks and institutions with better financial systems. Consequently, the efficiency of the financial intermediation process in a specific country should improve due to the increasing level of financial integration with the global markets. And, in line with this expectation, it is found that international financial integration reduces IPO underpricing.

The second argument is that international financial integration also works as a moderation effect, weakening the explanatory power of country institutions in the cross-country variation of IPO underpricing. In fact, international financial integration allows companies to access finance in the foreign markets and to borrow from foreign institutions. As a result, we find that the boundaries between capital markets in different countries fade away and the impact

of country institutions on IPO underpricing is weakened, which is consistent with the popular argument in the law and finance literature that the increasing globalization in general weakens the roles of country institutions in corporate finance (Doidge et al., 2007, Doidge et al., 2013, Kho et al., 2009, Stulz, 1999, Stulz, 2009). These two sets of results on the impact of international financial integration on IPO underpricing also indicate that the process of financial integration with the global market may improve the efficiency of primary markets internationally by driving the convergence of institutional quality across countries. The results also help us to understand the regional conditions for foreign IPO investment opportunities better as they provide issuers and underwriters with an insight into the economic effects of country institutions on IPO underpricing in a wider context of financial globalization.

Finally, from a methodological standpoint, a hierarchical linear modelling is applied to a large cross-country dataset that has a clustering structure, using a mixed-effects model. Moving away from a simple OLS estimation commonly used in the IPO literature, we are able to test the country-level effects and correct for the country clustering structure at the same time, which cannot be realized by a fixed effect model.

The rest of this chapter is organised as follows: the next section develops the research hypotheses and briefly summarizes the relevant literature other than that discussed in Chapter 2. Section 3.3 presents the data collection process and variable constructions as well as the methodology. Section 3.4 discusses the main results and a variety of robustness checks, while the last section concludes this study.

3.2 Literature Review and Hypothesis Development

To briefly recall, it is discussed in Chapter 2 that the mainstream literature on IPO underpricing focuses on pre-market activities following the information-asymmetry-based theories, or the aftermarket demand-driven behavioural arguments, with some other studies

focusing on the agency problems and allocation process of the IPO. Although the focus in previous literature has been on firm- and issuing-specific variables, more recent international studies show that country institutions are also important to explain the cross-country variation in IPO underpricing (Banerjee et al., 2011, Engelen and Essen, 2010, Hopp and Dreher, 2013, Doidge et al., 2013, Caglio et al., 2016). This study extends this branch of literature with a focus on the roles of international financial integration processes of a country in its IPO performance.

3.2.1 Impact of International Financial Integration on IPO Underpricing

IPOs represent complex financial deals where company information is not fully disclosed and the involvement of several independent institutions (i.e. issuer, investors and underwriters) makes the financial intermediation process highly relevant to understand the pricing dynamics as extensively studied in the literature. The most empirically supported theoretical setting is the information extraction theory by Benveniste and Spindt (1989). In short, they identify that the efficiency of the information extraction process, conducted by the underwriters, is critical to the level of underpricing.[7] As both the standards and the effort they put in this process is unobservable, the past performance of the IPOs that they have underwritten becomes a measure of the underwriters' reputation and quality. As a consequence, when underwriters either overprice or heavily underprice, their subsequent market share decreases, indicating the incentives of the investment banks to increase the efficiency of the financial intermediation process in order to set an appropriate offer price (Beaty and Ritter, 1986, Carter et al., 1998, Carter and Manaster, 1990, Chemmanur and Fulghieri, 1994, Nanda and Youngkeol, 1997, Sherman, 2005, Tinic, 1988).

There are different definitions of financial integration. Overall, it represents the level integration of a country's financial market with the global financial markets which is reflected

[7] For a detailed review on the Information Extraction Theory, please refer to Section 2.3.3 in Chapter 2.

in all aspects of finance activities, such as the ease of capital flows in and out of a country, the barriers to the domestic capital market and the restrictions on cross-border investments. As the financial integration process is associated with the domestic financial development and the quality of country institutions, a branch of literature has documented its influence on firm-level finance and governance activities. As to IPOs, financial integration affects the IPO valuation via the underwriting process. In particular, international financial integration impacts on the underwriting process because a market's financial openness to the rest of the world can *"increase the depth and breadth of domestic financial markets and lead to an increase in the degree of efficiency of the financial intermediation process"* (Agénor, 2003, pp.1095-1096). International financial integration significantly enhances the competition of the banking system through different mechanisms. Firstly, it increases the competition for domestic banks by raising the number of foreign banks operating in local markets (Caprio and Honohan, 1999) and allowing companies to access more affordable financing opportunities in foreign markets. As far as IPOs are concerned, financial integration reduces the costs and improves the likelihood of domestic companies going public abroad to access better institutional settings. International financial integration is found by Doidge et al. (2013) to increase the number of global IPOs. A recent study by Caglio et al. (2016) finds that more IPOs are actually underwritten by foreign banks when the home country has higher international financial integration. In general, financial integration also induces the shift of banks from the traditional loans and depository business to business in financial intermediation via securities (Hausler, 2002).

In response to the higher competition introduced by international financial integration, domestic banks learn from foreign banks and other institutions and tend to develop a better banking system (Caprio and Honohan, 1999). As a result, we expect domestic banks to become more effective information producers in the IPO process, improving the financial

intermediation process. According to the information extraction theory, the more effective the underwriting process is, the more information about the true value can be extracted from the informed investors at a lower cost, leading to a lower level of underpricing.

Finally and strictly for IPOs, Caglio et al. (2016) and Doidge et al. (2013) point out that world financial globalization increases the likelihood and reduces the cost of domestic companies going public abroad. Caglio et al. (2016) point out that companies are likely to use foreign IPOs as a means to escape from poor institutional environment in their home countries. Caglio et al. (2016) further show that a foreign IPO tends to choose a global underwriter, instead of a domestic one, if its home country has lower financial integration with the rest of the world. These further indicate the increasing incentives for underwriters to improve the intermediation process under the financial globalization process in order to stay competitive and maintain market shares.

As a more efficient underwriting process is associated with lower underpricing, all the above arguments indicate a negative relationship between the level of international financial integration and IPO underpricing and hence we form the first hypothesis as:

H1*: International financial integration reduces the cross-country variation of IPO underpricing.*

3.2.2 Moderation Effect of International Financial Integration

Alongside a direct relationship between international financial integration and IPO underpricing, we also argue that there is an indirect mechanism. Previous cross-country studies document that country-level institutional settings can also affect IPO activities and add to the

explanation on underpricing. Particularly, legal settings, such as the protection for minority investors, law enforcement, rule of law quality, corruption level and legal origin of a country are found to significantly affect the ex-ante uncertainty of the IPO valuation in a similar way as the firm- and issuing-level characteristics do (Banerjee et al., 2011, Engelen and Essen, 2010, Hopp and Dreher, 2013).[8]

However, a rise in the level of international financial integration weakens the importance of country institutions on corporate finance activities. Generally, this argument arises from the fact that financial integration allows greater flexibility as companies can choose the most suitable country institutions to which they are willing to be subjected by using the foreign markets. A strong but also implicitly reasonable argument is made by Stulz (2009, p. 350): *"In a fully integrated world, we would expect national capital markets to be irrelevant"*. He argues that the advantages of country institutions for domestic firms gradually disappear with international financial integration lowering the costs of international investments and capital raising, allowing firms to choose better institutions in a foreign market (Stulz, 1999, Stulz, 2009). Similarly, Kho et al. (2009) find a decreasing importance of country institutions for the level of home bias of the U.S. investors towards other countries over time. Doidge et al. (2007) argue that the impact of country institutions on corporate governance activities is weakened by more accessible global capital markets, while Doidge et al. (2013) show that international financial integration increases the number of global IPOs and weakens the effects of country institutions on the number and size of both domestic and global IPOs. Following this line of research, we extend the literature by examining the role of international financial integration as a moderation effect that weakens the roles that the country institutions play in

[8] For a more detailed review, please refer to Section 2.7 in Chapter 2.

explaining the cross-country variation of IPO underpricing. Our second hypothesis is formed as:

H2*: International financial integration of one country weakens the effects of its institutions on IPO underpricing.*

3.3 Data and Methodology

3.3.1 Sample and Variables

This study includes worldwide IPOs from January 1995 to December 2011. The data is collected from Thomson One New Issues Database, while the market-level data is sourced from Thomson Reuters DataStream Professional. Initially, we only include IPOs with information on both offer and first-trading-day closing price which is essential to measure the level of IPO underpricing. In line with previous studies, we exclude companies in the finance, insurance and real estate industries (SIC code between 60 and 67) and companies with missing observations. From a total of 9,958 deals, we apply a filtering process to obtain a final full sample of 8,954 IPOs from 37 countries by removing: IPOs with abnormal initial returns below -67% and above 2,000% (147) which is likely due to miscalculation or wrong data input[9]; IPOs using a private placement (279); IPOs listed in countries recognised as tax-haven non-sovereign jurisdictions—e.g. Bermuda and British Virgin Islands (263); outliers of IPO initial returns in the top and bottom 1st percentiles (235); and deals in countries with fewer than 5 IPOs during the overall sample period (80).

[9] This selection criterion is used by Banerjee et al. (2011).

The firm-level IPO underpricing is the dependent variable and is measured by the initial return (IR_i) on the first day of trading which is the percentage difference between the offer price (OP_i) and the closing price on the first day of trading ($CP_{1day,i}$):

$$IR_i = \frac{CP_{1day,i} - OP_i}{OP_i} * 100\% \quad \text{Equation 1}$$

This is the commonly used measure in the literature: the higher the initial return, the higher the IPO underpricing. A few studies adjust the IPO initial returns by the market performance. Many others adopt the unadjusted measure, as the average IPO underpricing is extremely high and the overall market performance is unlikely to affect the underpricing. Therefore, we keep the original form of IPO underpricing. Instead, we will control for the pre-IPO market performance in different specifications.

The main variable of interest in this study is the level of financial integration with the global markets for a country where the IPO is listed (or of which the IPO company is subjected to the institutional settings). Kose et al. (2010) compare several proxies of financial globalization and argue that the volume-based measure of international financial integration firstly proposed by Lane and Milesi-Ferretti (2003) is the most appropriate. This measure is also used by Doidge et al. (2013) and we similarly define the level of international financial integration in country j in year t as the ratio between the sum of external assets and liabilities of a country in that year and its annual GDP, as in Equation 2.[10]

[10] Lane and Milesi-Ferretti (2007) further update the dataset of external assets and liabilities by nation as well as the international financial integration based on the measurement by Lane and Milesi-Ferretti (2003).

$$International\ Financial\ Integration_{jt} = \frac{(External\ Assets_{jt} + External\ Liabilities_{jt}}{GDP_{jt}} * 100\% \quad \text{Equation 2}$$

Moreover, in the robustness check section, we also present four alternative measures of financial integration showing that our results are not driven by the choice of this measure. As Lane and Milesi-Ferretti (2003) argue, the level of financial globalization can be driven by a relaxation of policy restrictions, capital account liberalizations, an increase in goods trade and output per capita, domestic financial developments, privatization process, tax policy, etc. We also further separate financial integration from the overall market development by controlling for market returns and turnover, which also show a low level of correlation with financial integration.

The impact that the financial integration has on IPO underpricing is tested after controlling for firm- and issuing-level characteristics. In particular, IPO size (the product of the offer price and the number of shares offered) is used to proxy for the ex-ante uncertainty about the issuing company, as proposed by Beaty and Ritter (1986), and two dummy variables are created to capture whether the IPO is venture-capital-backed, and/or uses a bookbuilding method (factors reducing underpricing thanks to a process of information revelation). We also control for market-related variables. As we have discussed in Chapter 2, according to Loughran and Ritter (2002) and Ljungqvist et al. (2006), market return represents the market sentiment and is positively related to underpricing. We follow the literature and include the three-month cumulative market return before the IPO issuing date. We also control for markets with a relatively high number of deals during the year. Particularly, we define the *VOLUME* variable as the ratio between the number of IPOs in a specific year in one country divided by the total

number of IPOs in the same country during the sample period[11]. We also include the market turnover to further control for the market development, and the data is collected from DataStream.

As far as the second hypothesis is concerned, we include five country-level institutional variables that the previous empirical studies found significant in explaining IPO underpricing (Banerjee et al., 2011, Engelen and Essen, 2010, Hopp and Dreher, 2013). All country institutions are cross-sectional variables held constant for each country during the sample period.[12]

The *Investor Protection Index (IPI)* measures the level of minority investor protection in a country and has a negative impact on underpricing (Banerjee et al., 2011, Engelen and Essen, 2010). In countries where minority investors are not sufficiently protected, they tend to have less monitoring power over managers and big institutional investors and suffer from inappropriate managerial activities (e.g. self-dealing activities). In IPO events, the higher uncertainty around the company valuation makes investors reluctant to participate as they might become the minority investors. As a result, higher underpricing is required to attract these investors. Therefore, we expect a negative relationship between the level of minority investors' protection in a country and its IPO underpricing. Different from Banerjee et al. (2011) and Engelen and Essen (2010) who use the anti-self-dealing index constructed by Djankov et al. (2008) to capture the level of minority investor protection, we use the *Investor Protection Index (IPI)* which is the most recent data on the level of minority investor protection reported as part of the Doing Business project by the World Bank. The data is collected from the Doing Business

[11] This variable is calculated based on the IPOs recorded in the database before we apply any of the filtering criteria.
[12] This is a standard approach in the literature, also considering that there is very little (and insignificant) time-variation.

website[13] and ranges from 0 to 10 where higher values represent better protection of minority investors.

By dividing a country's legal system into 'law in books' (written laws) and 'law in action' (the effectiveness of legal enforcement), Engelen and Essen (2010) find that when the 'law in books' is relatively weak in protecting investors from controlling insiders and unjust deals, strong legal enforcement (i.e. effective police force or courts) can to some extent make up for the weak investor protection. Therefore, we expect a lower level of uncertainty about the IPO valuation associated with more efficient pubic enforcement. We obtain the *Public Enforcement Index (PEI)* as a proxy for the effectiveness of the legal enforcement from La Porta's website. The index ranges from 0 to 1, with higher values representing more effective legal enforcement.

Furthermore, we also include the *Rule of Law Index (RLI)* and the *Corruption Perception Index (CPI)* to proxy for the overall quality of a country's legal system (Engelen and Essen, 2010) and expect that better overall legal system is associated with less IPO uncertainty, thus lower underpricing. We use the *Rule of Law Index* constructed by the World Justice Project[14], ranging from 0 to 1 with higher values representing better overall legal systems. The *Corruption Perception Index*, provided by Transparency International[15], measures the level of corruption ranging from 0 (most corrupted environment) to 100 (least corrupted environment).

Finally, *ENGLISH* is a dummy variable that captures the status of a country's legal origin. It equals 1 if its legal system is originated from the *English Common Law* system and 0

[13] Doing Business project website: http://www.doingbusiness.org/
[14] For more details about how the rule of law index is constructed, please refer to the World Justice Project website. http://worldjusticeproject.org/
[15] Transparency International is an independent organization, which monitors the level of corruption in the world. Regarding the construction of the corruption perception index, please refer to their website. https://www.transparency.org/

otherwise. The data on legal origin is collected from La Porta et al. (1998). La Porta et al. (1998) and La Porta et al. (2000) point out that the legal protection is generally better in common law countries (i.e. USA and UK) than in civil law countries (i.e. German, French and Scandinavian law systems). Hence, following the literature, we expect a lower level of underpricing in countries with an English Common Law system.

3.3.2 Summary Statistics

Table 1 defines the variables adopted in this study with corresponding data sources and summary statistics. The high level of underpricing (average initial return of 26.62%), associated with a large standard deviation (45.47%), suggests the relevance of such phenomenon and its variation (both over time and across companies). This evidence is important, as we want to correct for several cross-sectional and time-varying phenomena to isolate the effect that financial integration has on IPO underpricing across countries and over time.

Table 2 is the summary of the average IPO underpricing by country from 1995 to 2011. We notice a large variation in the level of underpricing as well as in the number of IPOs across countries. In our sample, the United States has most observations with 3,383 IPOs, while China and Australia follow with 1,390 and 798 IPOs respectively. This dataset, in terms of IPOs and countries, is by far one of the largest in cross-country underpricing studies.[16] As we can see, all 37 countries experience different levels of underpricing over the sample period. China has the highest level of underpricing at 50.0% with Japan following with 40.3%, while Norway has the lowest one at 2.58% based on 54 IPOs. Brazil has an average underpricing of 8.01% in our sample and it differs from the 33.10% which is recorded in Loughran et al. (1994, updated in 2015). We explain this difference arguing that the sample period in Loughran et al. (1994,

[16] The ranking of the underpricing by country in this study is highly correlated (0.6) with the one reported in Jay Ritter's website, but single average figures are slightly different due to the use of different sample periods. Most of Jay Ritter's country IPO data go back to the 1970s, while ours start in the 1990s. The representativeness of our sample is also confirmed by the high correlation (0.7) of our underpricing figures with Banerjee et al. (2011).

updated in 2015) ranges from 1979 to 2011 which is considerably different from our sample size. Moreover, a recent study by Minardi et al. (2015) reports an average underpricing of 4.5% for Brazilian IPOs from 2004 to 2012 (similar to our sample period). Therefore, we believe that the underpricing for Brazil in our sample would not affect our results.[17]

In the second part of the analysis, we test the moderation effect that financial integration plays on the explanatory power of country institutions on underpricing. Table 3 presents the summary statistics of the variables used to proxy for different country-level institutional settings. Firstly, the correlation of different proxies is encouraging as it shows similar patterns across countries. The Investor Protection Index finds financially dominated countries/districts such as Hong Kong and Singapore among the highest ranked, while developing countries such as the Philippines and China are among the worst in protecting the minority investors, which is consistent with our expectation. To our surprise, Luxembourg shows a relatively low protection and the U.S., Germany and Sweden are only positioned around the average (even if still ranked above many other countries we would expect to have a lower protection). We find an explanation of this puzzle in the next index which measures the effectiveness of legal enforcement (*PEI*). In fact, the countries mentioned above show the highest value of legal enforcement, alongside Canada, Sweden and others, which makes up the relatively weak investor protection. The U.S. however, still remains a puzzle, which is solved when the overall legal system is considered (*RLI*). In fact, the U.S. is ranked top with other more efficient markets such as Australia, Canada, Hong Kong, Japan, Singapore, Scandinavian countries and the UK. Similar results are also found for the Corruption Perception Index, which shows a very high correlation (0.97) with the Rule of Law Index. Finally, we find that 34% of the countries in our study are originated from the English Common Law system.

[17] As a robustness check, we have run the models excluding IPOs from Brazil and the results do not change much.

3.3.3 Hierarchical Linear Modelling

We do not use OLS estimation which is a widely-adopted method in the IPO literature (even if we provide results with this methodology as a robustness check). Since our data clearly shows a hierarchical structure with IPOs nesting within the same country sharing similar patterns, Hierarchical Linear Modelling (HLM) (Raudenbush and Bryk, 1992) allows us to test the country institutions and control for the country effect at the same time, without violating the independence assumption of residuals. This methodology is also used by Engelen and Essen (2010). As Garson (2013) points out, in the presence of a nesting or clustering structure, observations from the same group are not independent and the standard errors of the predicted parameters by an OLS regression are underestimated. As a result, wrong or imprecise inferences might be made.

Particularly, we use a two-level HLM, where levels 1 and 2 represent respectively individual IPOs and countries which are treated as a random sample from a wider population. As a rule of thumb, a good HLM estimation needs at least 20 observations at level 2, and our dataset meets this requirement with 37 countries included. Among the different specifications of an HLM, we use a random intercept model, which allows for the level 1 intercept to shift between countries (i.e. the random factor is the country variable where correlated errors are created and slopes are parallel lines between countries).[18] In the random intercept model, the intercept of the IPO performance at level 1 is then modelled as a random effect of the relative country at level 2. The specification for hypothesis one is as follows:

H1: $$U_{ijt} = \beta_0 + \beta_1 IFI_{jt} + \beta_2 X_{ijt} + \mu_j + \varepsilon_{ijt}$$ Equation 3

[18] The other model is the random slope model, which allows the slope to differ across countries. In order to choose between these two models, we use a likelihood ratio test and the random intercept model is more appropriate.

Where U_{ijt} is the underpricing level for IPO i in country j in year t; IFI_{jt} is the level of international financial integration for country j in year t; X_{ijt} represents a vector of the control variables; μ_j is the random country effect shifting the regression line between countries; and ε_{ijt} is the overall error term at level 1.[19]

As mentioned in the data section above, we include five different country-level institutional variables to test the second hypothesis. In order to test the moderation effect, we follow the method used in Doidge et al. (2013) and use the interaction between international financial integration and each of the five institutional variables in order to capture that effect. As Baron and Kenny (1986) suggest that the specification should also include the two main effects in the interaction term, the specification for the second hypothesis is as follows:

$$\textbf{H2:} \quad U_{ijt} = \beta_0 + \beta_1 IFI_{jt} + \beta_2 I_j + \beta_3 (IFI_{jt} \times I_j) + \beta_4 X_{ijt} + \mu_j + \varepsilon_{ijt} \qquad \text{Equation 4}$$

where I_j is the institutional variable for country j; the variable of interest—$(IFI_{jt} * I_j)$—is the interaction term between the level of international financial integration of country *j* and the country *j* institutional variable; all other variables are the same as in Equation (3).

We start with a two-level null model to partition the variance in level 1 and level 2. For reasons of economy, and also considering that the model is simple, we do not report the

[19] Note that the random effect μ_j and the overall error term ε_{ijt} are independent of each other.

intermediate results. The model shows a between-country variance at 95.87 and a level 1 variance at 1935.45. Therefore, the between-country differences could explain about 5% of the variance in the cross-country IPO underpricing.

Table 1 Variables Description: Firm-, Issuing- and Country Characteristics (Chapter 3)

Variable	Description	Statistics				
		Obs	Mean	StD	Min	Max
IR	Initial Return (%), which measures the level of underpricing: difference between the offer price and the closing price of first trading day. Source: Thomson One	8954	26.62	45.47	-34.58	890
VB	A dummy variable that equals 1 if the IPO is venture capital backed; 0 otherwise. Source: Thomson One	8954	0.26	0.44	0	1
BB	A dummy variable that equals 1 if the IPO method is bookbuilding; 0 otherwise. Source: Thomson One	8954	0.68	0.47	0	1
LSIZE	Natural log of the total proceeds of the IPOs. Source: Thomson One	8954	3.29	1.79	-6.91	9.72
VOLUME	For each country-year companion, it is one year's number of IPOs in this country divided by the total number of IPOs throughout the sample period in this country, expressed in 100%. Source: Thomson One.	8954	6.92	3.01	0.4	31.23
MRETURN	Market return: 3-month cumulative market return before the IPO date, based on the market index in DataStream. Source: DataStream	8954	3.81	9.71	-40.46	80.16
TURNOVER	Stock market turnover: annual turnover by value in the year of IPO. Source: DataStream	8954	937.69	466.45	4.17	4227.25
IFI	International financial integration: a country's total external assets and liabilities divided by its GDP, expressed in 100%. This volume-based method is firstly recorded in Lane and Milesi-Ferretti (2003), and further explored and updated in Lane and Milesi-Ferretti (2007). For each company, the *IFI* of the country where it is first listed has been included. The most updated data is directly collected from Professor Philip R. Lane's website.	8546	364.52	500.62	61.98	2427.66

Table 1 Variables Description (Continued)

Variable	Description	Statistics				
		Obs	Mean	StD	Min	Max
IPI	Investor Protection Index: measures the level of the legal protection of minority investors in one country; it ranges from 0 to 10 with higher values representing better protection. For each company, the *IPI* of the country where it is first listed has been included. This data is directly collected from the website of the Doing Business project by the World Bank.	8548	6.499	0.936	4.2	8.2
PEI	Public Enforcement Index: measures the effectiveness of one country's legal enforcement, i.e. court enforcement; it ranges from 0 to 1 with higher values representing more effective legal enforcement (Djankov et al., 2008). For each company, the *PEI* of the country where it is first listed has been included. This data is directly collected from Professor Rafael La Porta's website. .	8548	0.181	0.338	0	1
RLI	Rule of Law Index: measures the overall quality of the legal framework, with higher values representing better legal systems. This data is constructed by the *World Justice Project* and collected from their website. For each company, the *RLI* of the country where it is first listed has been included.	8095	0.694	0.109	0.45	0.88
CPI	Corruption Perception Index: measures the level of the overall corruption, with 0 representing the most corrupted system. This data is constructed by *Transparency International* and collected from their website. For each company, the *CPI* of the country where it is first listed has been included.	8539	68.29	14.85	34	92
ENGLISH	A dummy variable, which equals 1 if the country's legal system originates from the English Common Law system. It is recorded in La Porta et al. (1998). For each company, the *ENGLISH* dummy of the country where it is first listed has been included.	8548	0.735	0.441	0	1

Table 2 IPO Underpricing by Country, 1995-2011

Country	**Mean**	**Std**	**N**	**Min**	**Max**
Argentina	29.58	41.11	6	0.38	108.19
Australia	19.54	38.07	798	-29.05	265.31
Austria	6.46	12.73	10	-8.57	27.78
Belgium	8.03	11.48	39	-2.93	45.45
Brazil	8.01	26.50	36	-12.5	153.94
Canada	24.95	41.68	286	-25.64	219.32
China	50.03	58.18	1390	-28.42	281.08
Cyprus	10.26	11.29	6	2.50	32.84
Denmark	11.07	18.45	9	-11.29	51.35
Finland	9.60	28.78	9	-26.71	80.72
France	3.29	10.10	237	-26.26	40.13
Germany	24.75	112.17	83	-16.00	890.00
Greece	17.88	43.31	49	-34.58	183.33
Hong Kong	14.80	33.85	332	-29.13	235.55
India	21.99	41.51	80	-29.14	213.82
Indonesia	21.94	32.04	79	-24.00	169.57
Israel	17.20	25.38	68	-14.93	99.05
Italy	4.67	8.24	57	-5.45	38.50
Japan	40.32	48.06	259	-29.01	241.15
Luxembourg	6.59	9.75	10	-8.00	25.40
Malaysia	28.15	47.01	251	-29.08	267.24
Mexico	8.51	12.59	9	-5.45	37.86
Netherlands	11.80	27.64	29	-9.45	137.19
New Zealand	12.43	17.35	30	-28.96	55.70
Norway	2.58	9.11	54	-23.19	40.30
Philippines	8.66	19.04	18	-17.44	50.27
Poland	22.74	33.79	28	-12.70	131.26
Singapore	22.38	40.30	183	-25.98	208.09
South Africa	24.36	40.86	11	-0.57	143.09
Spain	5.29	8.89	10	-3.09	19.10
Sweden	20.69	53.97	26	-22.17	230.00
Switzerland	9.46	14.11	25	-10.14	45.83
Taiwan	22.78	39.10	449	-11.40	233.36
Thailand	22.32	39.10	156	-26.60	184.38
Turkey	7.97	13.23	7	-4.66	31.03
United Kingdom	16.55	29.07	442	-26.16	276.09
United States	25.37	42.73	3383	-29.17	281.71
Total	**26.62**	**45.47**	**8953**	**-34.58**	**890**

Table 3 Institutional Variables by Country

Country	***IPI***	***PEI***	***RLI***	***CPI***	***ENGLISH***
Argentina	5.80	0.00	0.50	34.00	0
Australia	5.70	0.50	0.80	80.00	1
Austria	6.30	1.00	0.82	72.00	0
Belgium	6.20	0.50	0.76	76.00	0
Brazil	6.30	0.50	0.54	43.00	0
Canada	7.30	1.00	0.78	81.00	1
China	4.50	0.00	0.45	36.00	0
Cyprus	6.80	/	/	/	0
Denmark	6.80	0.75	0.88	92.00	0
Finland	5.60	0.00	0.84	89.00	0
France	6.80	0.50	0.74	69.00	0
Germany	5.90	1.00	0.80	79.00	0
Greece	5.80	0.50	0.59	43.00	0
Hong Kong	8.10	0.00	0.76	74.00	1
India	7.30	0.50	0.48	38.00	1
Indonesia	6.10	0.00	0.52	34.00	0
Israel	7.10	1.00	/	60.00	1
Italy	6.70	0.00	0.63	43.00	0
Japan	6.30	0.00	0.78	76.00	0
Luxembourg	4.70	1.00	/	82.00	0
Malaysia	7.40	1.00	0.58	52.00	1
Mexico	5.80	0.50	0.45	35.00	0
Netherlands	5.20	0.00	0.83	83.00	0
New Zealand	8.20	0.00	0.83	91.00	1
Norway	7.00	1.00	0.88	86.00	0
Philippines	4.20	0.00	0.50	38.00	0
Poland	6.30	1.00	0.67	61.00	0
Singapore	8.00	1.00	0.79	84.00	1
South Africa	6.80	0.00	0.55	44.00	1
Spain	6.40	1.00	0.67	60.00	0
Sweden	6.30	1.00	0.85	87.00	0
Switzerland	5.50	0.75	/	86.00	0
Taiwan	6.40	0.00	/	61.00	0
Thailand	6.60	0.00	0.52	38.00	1
Turkey	6.90	0.00	0.50	45.00	0
United Kingdom	7.80	0.00	0.78	78.00	1
United States	6.60	0.00	0.71	74.00	1
Mean	**6.35**	**0.43**	**0.66**	**61.71**	**0.31**

3.4 Results and Robustness Tests

3.4.1 Tests on the Direct Effect of Financial Integration

Table 4 reports the main results for the first hypothesis and the following discussion is focused on the coefficients reported in column 1, which is the base model using International Financial Integration (*IFI*). Consistent with the expectation, the finding shows that international financial integration at the country level reduces the IPO underpricing, improving the valuation certainty through a more efficient intermediation process. It also supports the argument in law and finance literature that the cost of external financing caused by information asymmetry and agency costs is reduced by increasing financial globalization (Stulz, 1999). With a standard deviation of 45.47 and 500.62 for initial returns and international financial integration respectively (see Table 1), a coefficient of -0.015 on *IFI* means that one standard deviation increase in *IFI* results in a 0.17 standard deviation decrease in the level of IPO underpricing. It also suggests that a 66% increase in *IFI* results in a 1% decrease in the level of underpricing, holding other variables constant. Using Taiwan as an example, financial integration doubled from 2002 (160%) to 2007 (320%) which would reduce the underpricing by over 3% on average. Considering the average size of an IPO and the money it leaves on the table, the result suggests an economically significant impact of international financial integration on the average underpricing.

Firm- and issuing-level control variables generally show expected signs which are consistent with most of the previous empirical findings. If we recall the detailed review on the roles of venture capitalists in IPO events in Chapter 2, many of the early studies based on the U.S. market find a negative relationship between the venture-capital status and the level of underpricing, supporting the certification role of venture capitalists proposed by Megginson and Weiss (1991). However, the reversed relationship has also been widely documented (Boeh and Dunbar, 2016, Guo et al., 2006, Liu and Ritter, 2011), supporting the analyst-lust theory by

Liu and Ritter (2011) who argue that venture capitalists have a great desire to attract the all-star analysts' coverage which can affect that price on the day when the shares are distributed to the limited shareholders, leading to a higher underpricing. We find a positive effect of the venture-capital status on the level of underpricing which further supports the analyst-lust theory.

As we have mentioned, bookbuilding status and company size are commonly-used measures for the ex-ante uncertainty about the valuation where the bookbuilding technique or big company size is associated with a lower level of information asymmetry. The findings of the negative effects of the bookbuilding technique and the size of the company on IPO underpricing further supports this argument and are in line with the majority of the empirical studies supporting the classic theories (Beaty and Ritter, 1986, Benveniste and Spindt, 1989, Reber and Vencappa, 2016, Rock, 1986).

We find a 0.5% reduction in IPO underpricing for each percentage point increase in the cumulative market return during the three months prior to the deal (*MRETURN*), which supports the 'hot issue' period argument by Ritter (1984) and the behavioural arguments that higher pre-IPO market return indicates higher sentiment demand from exuberant investors which leads to higher initial returns (Ljungqvist et al., 2006, Loughran and Ritter, 2002, Reber and Vencappa, 2016).

A positive relationship between *VOLUME* and underpricing is also identified in that we find that the IPOs issued in a year with a relative higher volume of IPO deals experience lower underpricing. This actually supports the information revelation argument by Altı (2005) who points out that there is an unknown common factor about the IPO valuation. This private information about the common factor is gradually revealed by the outcomes of previous IPOs because the IPO offer price is set according to the indications of the participating investors' interests.

Table 4 Direct Effect of Financial Integration on Underpricing (HLM)

Dependent Variable ***Underpricing***	**Hierarchical Linear Modelling**				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	De facto				***De jure***
	IFI	**Mixed-KOF**			***FOI***
		EGI	***Actual***	***Restrictions***	
VB	8.547***	8.926***	8.778***	9.029***	9.250***
	1.168	1.219	1.219	1.223	1.176
BB	-13.58***	-19.38***	-20.73***	-18.21***	-13.94***
	-1.522	-1.774	-1.798	-1.799	-1.636
LSIZE	-1.018***	-1.104***	-1.048***	-1.047***	-1.418***
	-0.332	-0.356	-0.356	-0.358	-0.339
VOLUME	-0.772***	-0.356**	-0.303*	-0.339*	-0.645***
	-0.164	-0.178	-0.177	-0.179	-0.168
MRETURN	0.499***	0.529***	0.520***	0.521***	0.573***
	0.048	0.054	0.054	0.055	0.05
TURNOVER	-0.008***	-0.007***	-0.006***	-0.008***	-0.009***
	-0.001	-0.001	-0.001	-0.001	-0.001
FG	-0.015***	-0.464***	-0.355***	-0.243***	-10.74***
	-0.001	-0.082	-0.059	-0.082	-0.679
Constant	44.20***	71.11***	60.71***	56.43***	55.40***
	2.885	6.665	4.893	7.341	3.444
var(c.country)	121.9***	102.5***	97.38***	131.4***	185.4***
	33.75	29.8	28.15	36.69	52.87
var(e.ir)	1,742***	1,807***	1,806***	1,811***	1,724***
	26.69	29.29	29.29	29.36	27.12
Observations	8,546	7,630	7,630	7,630	8,114
Number of groups	37	37	37	37	37

This table presents the regression results of the IPO underpricing from 1995 to 2011, by multi-level modelling. IPO underpricing is firstly modelled on firm level and then on country level. A random intercept model is assumed that the intercept shifts between countries due to the random country effect. Models (1) to (5) present the results using different measures of financial globalization (*FG*). The baseline model is Model (1) which uses a *de facto* measurement of financial globalisation-International Financial Integration (*IFI*). International Financial Integration is the percentage of total external assets and liabilities of one country to its GDP. Model (1) uses the full sample of 8546 observations from 37 countries. For the efficiency of the calculation, we choose countries which have a minimum number of IPOs equal or larger than 6. Model (2) uses a mixed measurement of financial globalization—the KOF Economic Globalization Index (*EGI*). The KOF Economic Globalization Index is the average of the actual flows and the restricted flows. Model (3) and (4) use the KOF actual flows (*Actual*) and the KOF restricted flows (*Restrictions*) separately. Model (5) uses the *de jure* measurement of financial globalization—Financial Openness Index (*FOI*) by Chinn and Ito (2006). It measures the country's capital account openness based on its restrictions on the cross-border financial transactions. The dependent variable is *Underpricing* which is the initial return between the first-trading day closing price and the IPO offer price, expressed as a percentage. *VB* captures the venture-backed status of the IPO firm and equals 1 if the IPO is venture capital-backed. *BB* is a dummy variable and equals 1 if the IPO uses book-building as an issuing technique. *LSIZE* is the offer size of the IPO, expressed in logarithm. *VOLUME*, for each country-year companion, is the number of IPOs in a certain year in one country divided by the total number of IPOs throughout the sample period in this country. *MRETURN* is the 3-month cumulative market return before the IPO, based on the country market index in DataStream. *TURNOVER* is the stock turnover by value recorded in DataStream which is the value of the shares traded divided by the average market capitalization. The figures below each coefficient are the standard errors. Significance at 10%, 5% and 1% levels are marked with *, **, and *** respectively.

Table 5 Direct Effect of Financial Integration on Underpricing (OLS)

Dependent Variable ***Underpricing***	**OLS**				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	De facto				***De jure***
	IFI	**Mixed-KOF**			***FOI***
		EGI	***Actual***	***Restrictions***	
VB	9.301***	7.896***	7.553***	11.37***	13.32***
	1.175	1.237	1.225	1.209	1.176
BB	-10.70***	-19.40***	-24.76***	-8.438***	-2.545**
	-1.291	-1.506	-1.818	-1.407	-1.260
LSIZE	1.154***	0.352	1.063***	0.404	-0.503*
	0.301	0.319	0.32	0.325	-0.298
VOLUME	-0.534***	-0.236	-0.05	-0.328**	-0.657***
	-0.146	-0.157	-0.154	-0.161	-0.149
MRETURN	0.439***	0.538***	0.470***	0.563***	0.593***
	0.064	0.071	0.073	0.074	0.064
TURNOVER	-0.002**	-0.000	-0.000	0.000	0.000
	-0.009	0.001	0.001	0.001	0.001
FG	-0.009***	-0.957***	-0.519***	-0.601***	-8.677***
	-0.001	-0.059	-0.038	-0.049	-0.480
Constant	34.48***	101.3***	65.93***	75.91***	42.66***
	1.785	5.215	3.535	4.716	2.033
Observations	8546	7630	7630	7630	8114
R-squared	0.035	0.069	0.052	0.051	0.079

This table presents the OLS regression results of the IPO underpricing from 1995 to 2011. Models (1) to (5) present the results with five different measures of financial globalization (*FG*). Model (1) uses a *de facto* measurement of financial globalisation-International Financial Integration (*IFI*). International Financial Integration is the percentage of total external assets and liabilities of one country to its GDP. Model (1) uses the full sample of 8546 observations. Model (2) uses a mixed measure of financial globalization—KOF Economic Globalization (*KOF*). The KOF Economic Globalization Index is the average of the actual flows and the restricted flows. Model (3) and (4) use the KOF actual flows (*Actual*) and the KOF restricted flows (*Restrictions*) separately. All indices are log-transformed. Model (5) uses the *de jure* measurement of financial globalization - Financial Openness Index (*FOI*). It measures the country's capital account openness based on its restrictions on the cross-border financial transactions. The dependent variable is *Underpricing* which is the initial return between the first-trading day closing price and the IPO offer price, expressed as a percentage. *VB* captures the venture-backed status of the IPO firm and equals 1 if the IPO is venture capital-backed. *BB* is a dummy variable and equal to 1 if the IPO uses book-building as an issuing technique. *LSIZE* is the offer size of the IPO, expressed in logarithm. *VOLUME*, for each country-year companion, is the number of IPOs in a certain year in one country divided by the total number of IPOs throughout the sample period in this country. *MRETURN* is the 3-month cumulative market return before the IPO, based on the country market index in DataStream. *TURNOVER* is the stock turnover by value recorded in DataStream which is the value of the shares traded divided by the average market capitalization. The figures below each coefficient are the standard errors. Significance at 10%, 5% and 1% levels are marked with *, **, and *** respectively.

We also compare the HLM estimates with simple OLS estimates. Results are presented in Model (1) in Table 5. According to Garson (2013), even though the second level random

factor should have no effect on the means of individual observations in the first level, it can change the covariance structure and hence make the estimates inefficient, reducing standard errors. All the results remain similar in the OLS estimation, with the exception of offer size that would seem to have a positive impact on underpricing, contrary to previous studies and our main HML approach. Moreover, the OLS model underestimates the effect of financial integration on underpricing by approximately 50%. The differences in our results are due to the random factors at level 2 which are not explicitly modelled in an OLS estimation. We also test for model preference using a likelihood ratio, which indicates that HLM, accounting for the country random effect, is to be preferred to an OLS estimation. Notwithstanding the normal use of simple OLS models in international IPO studies, we find overall confirmation that an HML structure should be adopted to research a micro-level phenomenon (underpricing) using a macroeconomic country-level argument.

3.4.2 Tests on the Moderation Effect of International Financial Integration

The baseline results on the second hypothesis are presented in Table 6. Models (1) to (5) include each of the country-level institutional variables respectively. Overall, the inclusion of country institutions in our models does not alter the significant and negative impact of international financial integration on IPO underpricing. At the same time, we find that a better legal protection of minority investors (*IPI*), a higher-quality legal framework (*RLI*), a more effective public enforcement (*PEI*), a lower level of corruption (*CPI*) and the existence of an English common law-based system (*ENGLISH*) in a country reduce the uncertainty of the ex-ante IPO valuation and hence level of underpricing, consistent with the other cross-country IPO studies mentioned above. These results provide further support to the recent development in the IPO literature which suggests that classic theories are not sufficient to account for the IPO outcomes and other factors, such as macroeconomic conditions, could also affect the IPO activities.

Table 6 Indirect Effect of Financial Integration on Cross- country IPO Underpricing

Dependent Variable ***Underpricing***	**Hierarchical Linear Modelling**				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	IPI	*PEI*	*RLI*	*CPI*	*ENGLISH*
VB	8.810***	8.488***	9.107***	9.108***	8.871***
	1.159	1.166	1.180	1.161	1.163
BB	-11.75***	-14.52***	-14.36***	-11.01***	-11.44***
	-1.512	-1.531	-1.635	-1.542	-1.54
LSIZE	-1.612***	-1.050***	-1.441***	-1.322***	-1.202***
	-0.332	-0.333	-0.341	-0.332	-0.333
VOLUME	-0.946***	-0.750***	-0.642***	-0.927***	-0.935***
	-0.163	-0.164	-0.168	-0.165	-0.165
MRETURN	0.532***	0.497***	0.585***	0.539***	0.529***
	0.047	0.047	0.050	0.047	0.047
TURNOVER	-0.010***	-0.008***	-0.007***	-0.011***	-0.011***
	-0.001	-0.001	-0.001	-0.001	-0.001
IFI	-0.087***	-0.016***	-0.220***	-0.069***	-0.040***
	-0.027	-0.001	-0.054	-0.019	-0.008
Institution	-17.37***	-20.47***	-165.5***	-1.091***	-33.20***
	-1.425	-4.122	-15.28	-0.102	-3.749
Interaction	0.012***	0.015***	0.287***	0.001***	0.036***
	0.003	0.004	0.071	0.000	0.008
Constant	156.7***	50.04***	153.6***	112.4***	63.54***
	9.913	3.065	10.80	7.298	4.146
var(c.country)	104.7***	103.3***	184.5***	249.2***	165.7***
	34.10	30.22	56.50	73.95	50.58
var(e.ir)	1,711***	1,738***	1,722***	1,710***	1,722***
	26.23	26.63	27.13	26.22	26.39
Observations	8546	8546	8093	8537	8546
Number of groups	37	37	37	37	37

This table presents the regression results of the IPO underpricing from 1995 to 2011, by multi-level modelling. IPO underpricing is firstly modelled on firm level and then on country level. A random intercept model assumes that the intercept shifts between countries due to the random country effect. Models (1) to (5) present the results including five different country-level institutional variables respectively. The dependent variable is *Underpricing* which is the initial return between the first-trading day closing price and the IPO offer price, expressed as a percentage. *VB* captures the venture-backed status of the IPO firm and equal to 1 if the IPO is venture capital-backed. *BB* is a dummy variable and equal to 1 if the IPO uses book-building as an issuing technique. *LSIZE* is the offer size of the IPO, expressed in logarithm. *VOLUME*, for each country-year companion, is the number of IPOs in a certain year in one country divided by the total number of IPOs throughout the sample period in this country. *MRETURN* is the 3-month cumulative market return before the IPO, based on the country market index in DataStream. *TURNOVER* is the stock turnover by value recorded in DataStream which is the value of the shares traded divided by the average market capitalization. *IFI* is the International Financial Integration which is the percentage of total external assets and liabilities of one country to its GDP. *Institution* represents each of the five country-level institutional variables from Model (1) to (5). *IPI* is the Investor Protection Index, which measures the level of legal protection of minority investors in one country; it ranges from 0 to 10 with higher values representing better protection. *PEI* is the Public Enforcement Index which measures the effectiveness of one country's legal enforcement, i.e. court enforcement; it ranges from 0 to 1 with higher values representing more effective legal enforcement. *RLI* is the Rule of Law Index, which measures the overall quality of the legal framework; it ranges from 0 to 100 with higher values representing a better legal system. *CPI* is the Corruption Perception Index, which measures the level of the overall corruption; it ranges from 0 to 100 with 0 representing the most corrupted system. *ENGLISH* is a dummy variable which equals 1 if the country's legal system originates from the English Common Law; 0 otherwise. The variable of interest here is *Interaction*, which is the interaction term between each of these institutional variables and *IFI*, i.e.

Interaction in Model (1) is equal to *IPI*IFI*. The figures below each coefficient are the standard errors. Significance at 10%, 5% and 1% levels are marked with *, **, and *** respectively.

However, the significantly positive coefficient of the interaction term (*IFI x Institutions*) signals that international financial integration acts as a moderation effect, reducing the extent to which country institutions affect the level of IPO underpricing. In other words, in a country which is more financially integrated with the global markets, institutional characteristics show a weaker effect on the IPO underpricing. This finding supports our second hypothesis and the argument in law and finance literature that financial globalization weakens the influences of country institutions in corporate finance activities. It is also consistent with Doidge et al. (2013) who find that financial globalization reduces the impact that country institutions have on the IPO issuances (size and numbers).

Particularly, in Model (1), the negative relationship between the level of minority investor protection (*IPI*) and the level of IPO underpricing is consistent with Banerjee et al. (2011), Engelen and Essen (2010) and Hopp and Dreher (2013), who argue that more underpricing is required to compensate the minority investors in a country where the investor's protection is insufficient. We show that this effect is weakened by improvements in the level of international financial integration. Models (2), (3), (4) and (5) also show a reduction in the direct negative relationship between underpricing and the level of Public Enforcement Index (*PEI*), the Rule of Law Index (*RLI*), the Corruption Perception Index (*CPI*) and the English common law dummy (*ENGLISH*) due to higher levels of international financial integration. Finally, we find that the results on the control variables do not change significantly compared to Model (1) in Table 4.

The interpretation of the interaction term between two continuous variables is not as straightforward as the one between categorical variables. For example, in Model (5) the high

absolute value of *ENGLISH* indicates that the average IPO underpricing in English common law countries is 33.2% lower than elsewhere. However, the positive coefficient of the interaction term indicates that this prominent impact is somewhat weakened by the increase in the level of international financial integration. When the level of international financial integration increases by 100%, the decrease in the average underpricing caused by the English common law system is reduced by 3.6%. However, the interpretation of the interaction term between two continuous variables, as in Models (1), (2), (3), and (4) in Table 6, requires more caution. Therefore, we estimate the models in which we re-centre international financial integration (*IFI*) at one standard deviation below (Equation 5) or above (Equation 6) its mean as follows:

$$IFI\_Low = IFI - (mean_{IFI} - 1sd) \quad \text{Equation 5}$$

$$IFI\_High = IFI - (mean_{IFI} + 1sd) \quad \text{Equation 6}$$

This procedure allows us to hold the international financial integration constant at 'high' (*IFI_Low* in Equation 6) and 'low' (*IFI_High* in Equation 5) values and compute the slopes of the country institutional variables under these two scenarios.

With financial integration assuming a value of zero, β_2 in Equation (4) simply represents the overall impact of country institutions (*I*) on IPO underpricing. However, the level of international financial integration is unlikely to reach a value of zero or below as there are hardly any countries showing zero financial contact with the rest of the world. Hence, by subtracting $(mean_{IFI} - 1sd)$ or $(mean_{IFI} + 1sd)$ from *IFI* respectively, a value of zero for

the newly constructed international financial integration is made meaningful. For example, IFI_Low can take the value of zero when international financial integration is held constant at one standard deviation below its mean ($(mean_{IFI} - 1sd)$). The interpretation of β_2 becomes straightforward as it simply represents the effect of country institutions on the level of underpricing, given a constant low/high level of financial integration (one standard deviation below/above the mean). Therefore, comparing the slopes on country institutional variables when international financial integration moves from a low to a high value, we expect the slope to flatten (i.e. the absolute value of the β_2 coefficient to decrease).

Estimation results are reported in Table 7 with Models (1) to (4) presenting estimations for four different country institutions: *IPI*, *PEI*, *RLI* and *CPI*. Under each model, we report two equations for international financial integration held at low (a) or high (b) values respectively. *Interaction_Low* and *Interaction_High* are the interaction terms between each of the country institutions and *IFI_Low* and *IFI_High* respectively. All the results on the control variables remain similar to the baseline results. As expected, Model (1) shows that the absolute value of the coefficient for *Institution* (*IPI*) decreases when international financial integration moves from low (Model (1a)) to high (Model (1b)) values. More specifically, a one unit increase in the level of investor protection results in a 18.99% decrease in the average underpricing when international financial integration is held at one standard deviation below its mean. However, the drop is reduced to 7.07% when international financial integration is increased by two standard deviations or held at one standard deviation above its mean. The same pattern is found on the remaining country institutional variables. The impact falls from 22.49% to 7.62% for law enforcement (*PEI*) and 1.21% to 0.30% for the corruption level (*CPI*). The only unconventional result is obtained with the rule of law index, which shows a positive (albeit insignificant) coefficient when international financial integration is high (see Model (3b)). This result indicates that international financial integration might not only decrease the impact of

country institutions on IPO underpricing, but also change the direction of their impact. Overall, the empirical results reported in Table 7 further support our second hypothesis and reinforce the evidence of the moderation effect of international financial integration in the relationship between the country institutions and the firm-level IPO underpricing. Further robustness tests are reported in the next section.

3.4.3 Robustness Tests

To test that our results are not driven by the choice of the financial integration measure, we use alternative measures to estimate models for the first hypothesis. Since international financial integration is a *de facto* measure, we then use a *de jure* measure and a mixed measure instead. Firstly, we employ the KOF Index of Globalization[20] and, similarly to Doidge et al. (2013), focus on one of its three components: Economic Globalization Index (*EGI*). This measure is constructed using an equally weighted combination of actual flows (*de facto* measure) and economic restrictions (*de jure* measure). We also test our models adopting these two components separately. The *de facto* measure of the actual flows is made by trade (22%), foreign direct investment (27%), portfolio investment (24%) and income payments to foreign nationals (27%), all as a percentage of GDP. The *de jure* measure of restrictions is computed using hidden import barriers (23%), mean tariff rate (28%), taxes on international trade (26%) and capital account restrictions (23%). Results reported in Models (2) to (4) in Table 4 are very similar to the baseline results in Model (1). A 1% increase in *EGI* results in a 0.46% reduction in the level of IPO underpricing. This impact reduces to 0.35% and 0.24% in Model (3) and (4), indicating that the actual flows of globalisation seems to have a stronger impact than the globalization measured by restrictions. As a further robustness check we adopt a *de jure* measure of financial integration constructed by Chinn and Ito (2006)—Financial Openness

[20] The KOF index is constructed by the KOF Swiss Economic Institute and is updated annually. The overall index consists of 36% economic globalization, 37% social globalization and 27% political globalization. The data and details on the index construction are available on the website: http://globalization.kof.ethz.ch/.

Index (FOI). The Financial Openness Index (FOI) measures a country's capital account openness based on its restrictions on cross-border financial transactions.[21] Restrictions are reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). Consistent with previous findings, we confirm the significant effects of the international financial integration on IPO underpricing.

We also use all these alternative proxies for financial integration in the OLS estimations, reporting results in Models (2) to (5) in Table 5. As not much changes, they further confirm the main findings.

In the previous section, we strengthen the inference of our second hypothesis (moderation effect) by holding the international financial integration (*IFI*) constant at high and low levels, as in Table 7. We further test the robustness of the results replacing the measure of international financial integration with the Financial Openness Index in Table 8. The results on FOI, country institutions, interaction terms and control variables are not significantly different from the baseline results presented in Table 6.

[21] The data on the Financial Openness Index is available on the website: http://web.pdx.edu/~ito/Chinn-Ito_website.htm.

Table 7 Interpretation of the Moderation Effect: Constant Low/High Value of *IFI*

Dependent Variable ***Underpricing***	**Hierarchical Linear Modelling**							
	(1a)	**(1b)**	**(2a)**	**(2b)**	**(3a)**	**(3b)**	**(4a)**	**(4b)**
	IPI		*PEI*		*RLI*		*CPI*	
	Low	*High*	*Low*	*High*	*Low*	*High*	*Low*	*High*
VB	8.810***	8.810***	8.488***	8.488***	9.107***	9.107***	9.108***	9.108***
	1.159	1.159	1.166	1.166	1.18	1.18	1.161	1.161
BB	-11.75***	-11.75***	-14.52***	-14.52***	-14.36***	-14.36***	-11.01***	-11.01***
	-1.512	-1.512	-1.531	-1.531	-1.635	-1.635	-1.542	-1.542
LSIZE	-1.612***	-1.612***	-1.050***	-1.050***	-1.441***	-1.441***	-1.322***	-1.322***
	-0.332	-0.332	-0.333	-0.333	-0.341	-0.341	-0.332	-0.332
VOLUME	-0.946***	-0.946***	-0.750***	-0.750***	-0.642***	-0.642***	-0.927***	-0.927***
	-0.163	-0.163	-0.164	-0.164	-0.168	-0.168	-0.165	-0.165
MRETURN	0.532***	0.532***	0.497***	0.497***	0.585***	0.585***	0.539***	0.539***
	0.047	0.047	0.047	0.047	0.050	0.050	0.047	0.047
TURNOVER	-0.010***	-0.010***	-0.008***	-0.008***	-0.007***	-0.007***	-0.011***	-0.011***
	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
IFI_Low	-0.087***		-0.016***		-0.220***		-0.069***	
	-0.027		-0.001		-0.054		-0.019	
IFI_High		-0.087***		-0.016***		-0.220***		-0.069***
		-0.027		-0.001		-0.054		-0.019
Institution	-18.99***	-7.070***	-22.49***	-7.616***	-204.6***	83.20	-1.215***	-0.304
	-1.686	-2.642	-4.492	-2.764	-22.29	54.09	-0.123	-0.193

Table 7 Interpretation of the Moderation Effect: Constant Low/High Value of *IFI* (Continued)

Dependent Variable	**Hierarchical Linear Modelling**							
Underpricing	**(1a)**	**(1b)**	**(2a)**	**(2b)**	**(3a)**	**(3b)**	**(4a)**	**(4b)**
Interaction_Low	0.012***		0.015***		0.287***		0.001***	
	0.003		0.004		0.071		0.000	
Interaction_High		0.012***		0.015***		0.287***		0.001***
		0.003		0.004		0.071		0.000
Constant	168.6***	81.25***	52.27***	35.91***	183.5***	-36.40	121.8***	52.61***
	12.15	20.54	3.103	3.090	16.04	42.30	8.629	15.49
var(c.country)	104.7***	104.7***	103.3***	103.3***	184.5***	184.5***	249.2***	249.2***
	34.10	34.10	30.22	30.22	56.50	56.50	73.95	73.95
var(e.ir)	1,711***	1,711***	1,738***	1,738***	1,722***	1,722***	1,710***	1,710***
	26.23	26.23	26.63	26.63	27.13	27.13	26.22	26.22
Observations	8546	8546	8546	8546	8093	8093	8537	8537
Number of groups	37	37	37	37	37	37	37	37

This table presents the regression results of the IPO underpricing from 1995 to 2011, by multi-level modelling, when the moderator variable—international financial integration (*IFI*)—is held constant at low and high values for each institutional variable. IPO underpricing is firstly modelled on firm level and then on country level. A random intercept model assumes that the intercept shifts between countries due to the random country effect. Model (1) to (4) presents the results including four continuous country-level institutional variables respectively. The dependent variable is *Underpricing* which is the initial return between the first-trading day closing price and the IPO offer price, expressed as a percentage. *VB* captures the venture-backed status of the IPO firm and equals 1 if the IPO is venture capital-backed. *BB* is a dummy variable and equals 1 if the IPO uses book-building as an issuing technique. *LSIZE* is the offer size of the IPO, expressed in logarithm. *VOLUME*, for each country-year companion, is the number of IPOs in a certain year in one country divided by the total number of IPOs throughout the sample period in this country. *MRETURN* is the 3-month cumulative market return before the IPO, based on the country market index in DataStream. *TURNOVER* is the stock turnover by value recorded in DataStream which is the value of the shares traded divided by the average market capitalization. Under each model, there are two models – *(a) and (b)* - where *IFI* is held constant at low *(IFI_Low)* and high *(IFI_High)* values. *IFI_Low* is the international financial integration held constant at 1 standard deviation below the mean, and *IFI_High* is the international financial integration held constant at 1 standard deviation above the mean. International Financial integration is the percentage of total external assets and liabilities of one country to its GDP. *Institution* represents each of the four country-level institutional variables from Model (1) to (4). *IPI* is the Investor Protection Index, which measures the level of the legal protection of minority investors in one country; it ranges from 0 to 10 with higher values representing better protection. *PEI* is the Public Enforcement Index which measures the effectiveness of one country's legal enforcement, i.e. court enforcement; it ranges from 0 to 1 with higher values representing more effective legal enforcement. *RLI* is the Rule of Law Index, which measures the overall quality of the legal framework; it ranges from 0 to 100 with higher values representing better legal system. *CPI* is the Corruption Perception Index, which measures the level of the overall corruption; it ranges from 0 to 100 with 0 representing the most corrupted system. *Interaction_Low* and *Interaction_High* is the interaction term between each institutional variable and *IFI_Low* and *IFI_High* respectively; i.e. *Interaction_Low* in Model (1a) is equal to *IPI*IFI_Low*. The statistics shown under each coefficient are the standard errors. Significance at 10%, 5% and 1% levels are marked with *, **, and *** respectively.

Table 8 Indirect Effect of Financial Openness Index on Cross-country IPO Underpricing

Dependent Variable ***Underpricing***	**Hierarchical Linear Modelling**				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	IPI	*PEI*	*RLI*	*CPI*	*ENGLISH*
VB	9.211***	9.176***	9.149***	9.279***	9.309***
	1.177	1.174	1.178	1.173	1.176
BB	-13.01***	-13.73***	-14.14***	-14.25***	-13.43***
	-1.641	-1.65	-1.639	-1.634	-1.624
LSIZE	-1.525***	-1.471***	-1.489***	-1.437***	-1.593***
	-0.337	-0.338	-0.339	-0.338	-0.339
VOLUME	-0.727***	-0.692***	-0.670***	-0.653***	-0.746***
	-0.167	-0.167	-0.168	-0.168	-0.167
MRETURN	0.592***	0.586***	0.583***	0.582***	0.594***
	0.050	0.050	0.050	0.050	0.050
TURNOVER	-0.009***	-0.009***	-0.008***	-0.009***	-0.008***
	-0.001	-0.001	-0.001	-0.001	-0.001
FOI	-32.41***	-11.86***	-36.01***	-32.92***	-13.22***
	-5.104	-0.723	-6.962	-4.660	-1.188
Institution	-11.40***	-35.53***	-151.6***	-1.296***	-28.41***
	-1.521	-5.534	-25.11	-0.221	-4.111
Interaction	4.522***	13.98***	56.55***	0.567***	13.40***
	0.827	2.377	12.01	0.097	2.107
Constant	116.4***	62.51***	131.9***	107.1***	63.66***
	8.816	3.513	13.60	10.13	3.270
var(c.country)	90.88***	145.9***	136.7***	161.3***	106.3***
	29.63	43.26	41.36	47.48	35.24
var(e.ir)	1,717***	1,717***	1,722***	1,715***	1,717***
	-27.00	-27.00	-27.11	-27.00	-27.01
Observations	8114	8114	8093	8105	8114
Number of groups	37	37	37	37	37

This table presents the regression results of the IPO underpricing from 1995 to 2011, by multi-level modelling, when the volume-based international financial integration is replaced with the *de jure* measure—Financial Openness Index (*FOI*). IPO underpricing is firstly modelled on firm level and then on country level. A random intercept model assumes that the intercept shifts between countries due to the random country effect. Models (1) to (5) present the results including five different country-level institutional variables respectively. Financial Openness Index (*FOI*) measures the country's capital account openness based on its restrictions on the cross-border financial transactions. The dependent variable is *Underpricing* which is the initial return between the first-trading day closing price and the IPO offer price, expressed as a percentage. *VB* captures the venture-backed status of the IPO firm and equals 1 if the IPO is venture capital-backed. *BB* is a dummy variable and equals 1 if the IPO uses book-building as an issuing technique. *LSIZE* is the offer size of the IPO, expressed in logarithm. *VOLUME*, for each country-year companion, is the number of IPOs in a certain year in one country divided by the total number of IPOs throughout the sample period in this country. *MRETURN* is the 3-month cumulative market return before the IPO, based on the country market index in DataStream. *TURNOVER* is the stock turnover by value recorded in DataStream which is the value of the shares traded divided by the average market capitalization. *Institution* represents each of the five country-level institutional variables from Model (1) to (5). *IPI* is the Investor Protection Index, which measures the level of the legal protection of minority investors in one country; it ranges from 0 to 10 with higher values representing better protection. *PEI* is the Public Enforcement Index which measures the effectiveness of one country's legal enforcement, i.e. court enforcement; it ranges from 0 to 1 with higher values representing more effective legal enforcement. *RLI* is the Rule of Law Index, which measures the overall quality of the legal framework; it ranges from 0 to 100 with higher values representing a better legal system. *CPI* is the Corruption Perception Index, which measures the level of the overall corruption; it ranges from 0 to 100 with 0 representing the most corrupted system. *ENGLISH* is a dummy variable which equals 1 if the country's legal system originates from English Common

Law; 0 otherwise. The variable of interest here is *Interaction*, which is the interaction term between each of these institutional variables and *FOI*, i.e. *Interaction* in Model (1) is equal to *IPI*FOI*. The figures below each coefficient are the standard errors. Significance at 10%, 5% and 1% levels is marked with *, **, and *** respectively.

Table 9 Interaction between Mean-centred Financial Integration and Country Institutions

Dependent Variable ***Underpricing***	**Hierarchical Linear Modelling**				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	Cen_IPI	*Cen_PEI*	*Cen_RLI*	*Cen_CPI*	*Cen_ENGLISH*
VB	8.810***	8.488***	9.107***	9.108***	8.871***
	1.159	1.166	1.18	1.161	1.163
BB	-11.75***	-14.52***	-14.36***	-11.01***	-11.44***
	-1.512	-1.531	-1.635	-1.542	-1.540
LSIZE	-1.612***	-1.050***	-1.441***	-1.322***	-1.202***
	-0.332	-0.333	-0.341	-0.332	-0.333
VOLUME	-0.946***	-0.750***	-0.642***	-0.927***	-0.935***
	-0.163	-0.164	-0.168	-0.165	-0.165
MRETURN	0.532***	0.497***	0.585***	0.539***	0.529***
	0.047	0.047	0.050	0.047	0.047
TURNOVER	-0.010***	-0.008***	-0.007***	-0.011***	-0.011***
	-0.001	-0.001	-0.001	-0.001	-0.001
Cen_IFI	-0.010*	-0.014***	-0.020***	-0.007***	-0.040***
	-0.005	-0.001	-0.006	-0.003	-0.008
Cen_Institution	-13.03***	-15.05***	-60.70***	-0.759***	-20.20***
	-1.410	-3.280	-21.17	-0.099	-2.920
Interaction	0.012***	0.015***	0.287***	0.001***	0.036***
	0.003	0.004	0.071	0.000	0.009
Constant	40.22***	41.36***	31.44***	35.35***	49.10***
	2.790	2.820	3.772	3.552	3.396
var(c.country)	104.7***	103.3***	184.5***	249.2***	165.7***
	34.10	30.22	56.50	73.95	50.58
var(e.ir)	1,711***	1,738***	1,722***	1,710***	1,722***
	26.23	26.63	27.13	26.22	26.39
Observations	8546	8546	8093	8537	8546
Number of groups	37	37	37	37	37

This table presents the regression results of the IPO underpricing from 1995 to 2011, by multi-level modelling, when the International Financial Integration and institutional variables are mean-centred before interacting them. IPO underpricing is firstly modelled on firm level and then on country level. A random intercept model assumes that the intercept shifts between countries due to the random country effect. Models (1) to (5) present the results including five different mean-centred country-level institutional variables respectively. The dependent variable is *Underpricing* which is the initial return between the first-trading day closing price and the IPO offer price, expressed as a percentage. *VB* captures the venture-backed status of the IPO firm and equals 1 if the IPO is venture capital-backed. *BB* is a dummy variable and equals 1 if the IPO uses book-building as an issuing technique. *LSIZE* is the offer size of the IPO, expressed in logarithm. *VOLUME*, for each country-year companion, is the number of IPOs in a certain year in one country divided by the total number of IPOs throughout the sample period in this country. *MRETURN* is the 3-month cumulative market return before the IPO, based on the country market index in DataStream.

TURNOVER is the stock turnover by value recorded in DataStream which is the value of the shares traded divided by the average market capitalization. *Cen_IFI* is the mean-centred International Financial Integration. International Financial Integration is the percentage of total external assets and liabilities of one country to its GDP, expressed in logarithm. *Institution* represents each of the five mean-centred country-level institutional variables from Model (1) to (5). *Cen_IPI* is the mean-centred Investor Protection Index, which measures the level of the legal protection of minority investors in one country; it ranges from 0 to 10 with higher values representing better protection. *Cen_PEI* is the mean-centred Public Enforcement Index which measures the effectiveness of one country's legal enforcement, i.e. court enforcement; it ranges from 0 to 1 with higher values representing more effective legal enforcement. *Cen_RLI* is the mean-centred Rule of Law Index, which measures the overall quality of the legal framework; it ranges from 0 to 100 with higher values representing better legal system. *Cen_CPI* is the mean-centred Corruption Perception Index, which measures the level of the overall corruption; it ranges from 0 to 100 with 0 representing the most corrupted system *Cen_ENGLISH* is the mean-centred dummy variable which equals 1 if the country's legal system originates from the English Common Law; 0 otherwise. The variable of interest here is *Interaction*, which is the interaction term between each of the mean-centred institutional variables and the mean-centred *IFI*, i.e. *Interaction* in Model (1) is equal to *Cen_IPI*Cen_IFI*. The figures below each coefficient are the standard errors. Significance at 10%, 5% and 1% levels is marked with *, **, and *** respectively.

Furthermore, a general concern linked to the inclusion of an interaction term is the increased multicollinearity, which might affect the precision of the inferences. To test for the impact of increased collinearity on our estimation, we follow Aiken and West (1991) and Jaccard and Turrisi (2003) and mean-centre the two variables before interacting them in order to minimise the collinearity caused by interactions, as showed by Equation 7 in the following:

$$Cen\_Interaction = (IFI - mean\_IFI) * (I - mean\_I) \quad \text{Equation 7}$$

where IFI is the level of international financial integration; $mean\_IFI$ is its mean across all observations; I represents a country-level institutional variable; and $mean\_I$ is its mean across countries. We expect no big changes in the results as the significant impacts should not be driven by the slightly increased collinearity due to interactions. Results are presented in Table 9 where Models (1) to (5) present different country institutions as in Table 6. Consistent with our expectation, all models show that the centred variables have different coefficients but the same significance, signalling that our results are not driven by an increased collinearity induced by the interaction term between financial integration and home institutions.

We have also run other robustness checks, the results of which are not fully reported in this paper for reasons of economy. For example, results are also robust to the introduction of year dummies, with coefficients showing values and statistical significance in line with the main models. A further two tests are conducted in order to confirm that the financial integration reduces the IPO underpricing for not only foreign IPOs but also domestic ones. Firstly, we exclude all foreign IPOs and estimate the main model (with both HLM and OLS) using a reduced sample of domestic IPOs only and find no significant differences in our results. Secondly, we include a dummy variable indicating foreign IPOs which is then interacted with financial integration. All the main results on financial integration, country institutions and their interactions remain similar to the initial results. While most of the specifications have returned insignificant coefficients of the interaction term between financial globalization and foreign IPO dummy, some weakly suggest that foreign IPO might experience greater impact from financial integration. In other words, while both domestic and foreign IPOs experience a decrease in underpricing when financial globalization increases, the scale of the decrease in foreign IPO underpricing is greater. Both tests strengthen the findings and eliminate the concerns that international financial integration of a country only impacts on foreign IPOs. Although the average underpricing of Brazil in our sample is similar to more recent studies, it still might arouse concern as it is significantly smaller than what is reported on Ritter's website, as mentioned earlier. We then estimate the models excluding Brazilian IPOs and the results still hold. Overall, the results stand through all the above robustness checks and support both hypotheses.

3.5 Summary

By using a hierarchical linear modelling with nearly 9,000 IPOs from 37 countries, this study presents evidence that IPO underpricing decreases when the IPO listing country is more financially integrated with the rest of the world. Particularly, we argue that a direct effect is

firstly obtained through an improved efficiency of the financial intermediation process because of the increased external competition by financial integration. Therefore, financial integration improves the efficiency of IPO pricing for both domestic and foreign IPOs. As the underpricing is reduced in both domestic and foreign IPOs, this effect could have two possible explanations: firstly, companies going public domestically benefit from a higher competition in the home market which decreases the information asymmetry, making the pricing process more transparent. Secondly, foreign IPOs may benefit from listing countries with an improved efficiency. Importantly, we find that this relationship is not altered by the use of both *de jure* and *de facto* measures of financial integration and it does not represent a phenomenon that is restricted to a specific period or part of the business cycles.

We further identify an indirect channel where financial integration impacts on IPO underpricing by diminishing the roles that country institutions play in the development of financial markets. Once financial integration is accounted for, we find that the impact of country institutions on IPO underpricing weakens. Hence, we argue that financial integration has a moderation effect that reduces the explanatory power of country institutions in IPO underpricing.

The findings in this study also support previous literature in international corporate finance, providing extra evidence that financial integration not only lowers the cost of external financing but also weakens the roles of country institutions on corporate finance decisions. By identifying the effects of financial integration, this work does not only add to the literature with new explanation on IPO underpricing (especially cross-country variation), but it also presents a macroeconomic approach to investigate corporate finance activities. The findings provide issuers, underwriters and investors with some insights into the roles that country institutional settings play in IPO markets and how these roles can be altered by improvements in financial integration, which are of particular use to the policy makers in the emerging markets which are

more prone to the globalization process and the practitioners of foreign IPOs which have been growing popular thanks to the financial globalization.

If we recall the detailed literature review in Chapter 2, we know that the information-asymmetry-based theories argue that the IPO initial return arises from the pre-IPO pricing while the behavioural arguments believe that it is after-market investor driven. The findings in this study generally support both the classic theories and the behavioural arguments, implying that both the pricing of IPO shares and the investor-trading after the listing explain the abnormally high initial returns. However, we cannot rule out the possibility that the significant effects are driven by a larger portion of western data in the sample rather than being "universal". As a matter of fact, the following chapters with single country datasets tell a different story regarding the efficiency of classic and behavioural theories on IPO short-run outcomes.

Finally, we envisage the scope of this work to develop in two main directions. Firstly, as we argue that the direct effect is transmitted through the financial intermediation process, this mechanism could be further tested by examining how the gross spread and market share of investment banks is affected. Secondly, as this work uses a static cross-sectional measure of legal systems, the impact and role of the dynamic development of legal systems and its interaction with improvements in financial integration may be tested in relation to the IPO underpricing phenomenon, subject to data availability.

Chapter 4 : Urban Economic Openness and IPO Underpricing

In the previous chapter, we have identified the impact of country-level financial integration on firm-level IPO performance and its interactions with the country-level institutional settings. In this chapter, we extend the scope to a domestic regional study which examines how regional economic openness can also affect the IPO valuation, with a unique sample of Chinese real estate companies.

4.1 Introduction

The underpricing of IPOs in emerging markets is extremely high and previous research applying models used in developed markets has failed to explain this phenomenon and its cross-sectional variation (Mok and Hui, 1998, Chan et al., 2004, Gao, 2010, Tian, 2011). As discussed in Chapter 2, classic theories which argue that firm-specific features (e.g. size and age) reflect the level of uncertainty of the firm's valuation and behavioural arguments which believe that market sentiment also drives the first-day return have long been the main explanations for IPO underpricing, at least in developed markets. Over the last two decades a new stream of literature has shown that the level of trade openness (or integration with the global markets) experienced by a region affects the pricing of assets located in that region. Hence, it is reasonable to expect that the openness (or integration) of the region where a company operates should impact on its IPO pricing. This study is developed on top of this evidence and combines these two research streams to explain the IPO underpricing in emerging markets using a macroeconomic approach.

Trade openness can affect IPO performance in several ways. In particular, we examine urban economic openness (UEO), which is defined as the degree of trade a certain region or urban area within a country has with foreign countries. The UEO of a company would then be measured as the relative degree of trade between the regions where the issuing company invests and their foreign counterparties. The effect of UEO on a company's IPO valuation can be

transmitted through different channels. Firstly, a city with higher trade openness should experience a more pronounced growth in productivity and output. As a consequence, the demand for real estate increases. Given the short-term inelastic housing supply, property prices increase, driving the valuation of companies up. Secondly, a company operating in a city with higher UEO can benefit from the increase in local real estate prices through the Balassa-Samuelson effect. For the first time, Balassa (1964) and Samuelson (1964) explore the connection between trade openness and the market of non-tradable goods. When the international trade increases, the tradable sector experiences a greater productivity increase than the non-tradable sector due to the more efficient information spillover, bigger market size and faster technology development, leading to a higher output in the tradable sector. However, as labour is mobile across regions and industries, the average wage should equally increase (Samuelson, 1964, Dollar, 1992, Sachs and Warner, 1995, Edwards, 1998, Miller and Upadhyay, 2000). As a result, there will be an increase in the relative prices of non-tradable goods as compared to tradable goods. Considered as the largest non-tradable asset, it is reasonable to expect that real estate prices should increase in areas with higher UEO, leading to a rise in the profitability of real estate companies.[22] Thirdly, an increase in the UEO of a city can also lead to a rise in property prices by fostering an increase in the foreign (and domestic) real estate investments in more open regions, due to an easier flow of capital—Baltagi et al. (2009), Basu and Morey (2005), Beck (2002), Law (2008), and Svaleryd and Vlachos (2002). Finally, companies could increase their profitability not only indirectly through the change in their asset price, but also directly through the increase in the overall productivity in regions with high UEO (Demsetz, 1973, Peltzman, 1977, Eilon, 1985, Jovanovic, 1982, Stierwald, 2010).[23]

[22] The Balassa-Samuelson effect is supported by empirical studies showing that the productivity growth in real output would finally increase the relative price of non-tradable goods—see De Gregorio et al. (1994) and Deloach (2001).

[23] Please refer to Dollar (1992), Sachs and Warner (1995), Edwards (1998), and Miller and Upadhyay (2000) for the impact of trade openness on productivity.

Overall, the above mechanisms demonstrate how UEO can decrease the uncertainty about the company's future earnings, leading to a more accurate firm valuation. According to the classic theories that lower uncertainty about the IPO valuation is associated with lower underpricing, we expect a negative relationship between the *UEO* and IPO underpricing.

While it is methodologically difficult to empirically identify this relationship, we believe that the Chinese real estate sector presents a suitable laboratory. Firstly, since the IPO underpricing in this sector is high and varies across companies, the significant variation of openness across Chinese regions may be related to a different geographical investment focus of issuing firms. China is a developing country with cities rich with development opportunities and almost all real estate companies include a significant development portfolio (reported as inventory or intangible asset in financial reports along with buildings held as investments). The land is owned by the central government and each company bids for land-use rights, the value of which is reported in the IPO prospectus. Secondly, because companies need to bid for the land-use rights from local governments, most real estate firms tend to concentrate their businesses in one area where they believe they have informational advantages. This might be caused by future development opportunities in a city, as well as connections with local governments and institutions to obtain land-use rights. In fact, Miao and Zhu (2005) show that Chinese real estate markets are still very much localised (with varying regional policies and regulations). As a consequence, the barriers to enter a new market are so high that most real estate companies prefer to remain focused in one region and compete with other local real estate companies than to diversify geographically. Finally, even if some companies operate across regions (normally two main areas representing a significant proportion of the overall portfolio) the real estate business (investing in physical immobile assets, i.e. buildings and land) allows us to identify the exact portfolio of locations where the business is operated. Consequently, an index of urban economic openness can be constructed at a company level based on the locations

where the company hold real estate assets and the level of trade openness each location experiences.

In this study, we collect data of Chinese real estate IPOs from 1992 to 2013 and find that, after controlling for firm- and issue-specific characteristics, UEO significantly and negatively affects IPO underpricing. Companies operating in cities with higher UEO experience less underpricing when they go public and this result remains robust once we account for the IPO location, ownership structure and other market conditions. The findings of this study help issuers, underwriters and investors to better understand the dynamics of IPO markets in emerging markets and their relation to the wider economy. They also provide policy implications with regard to the ties between the local economy and the performance of regional firms and implications for state-owned companies going public. The finding that the urban economic openness reduces the extremely high initial returns of IPOs also acts as further evidence supporting the idea that the openness improves the financial development. By using the real estate sector as a testing ground, this study sheds some light on the underpinning of the underlying real assets in real estate IPO valuation. In the end, although focusing on the Chinese market, our results could also apply to other countries and sectors with similar market structures.

The rest of this study is structured as follows: the next section presents the hypothesis development and a brief review of the relevant literature other than that in Chapter 2. Section 3.3 describes the data and the methodology. Empirical results and robustness tests are discussed in Section 3.4, while main conclusions are presented in the last section.

4.2 Literature Review and Hypothesis Development

As mentioned above, the hypothesis is that the urban economic openness has a negative impact on IPO underpricing of Chinese real estate companies whose businesses are in this region, which is developed in the following strands of literature.

On the one hand, a large number of empirical studies focusing on developed markets find confirmation of the mainstream theories or models elaborated on in Chapter 2; on the other hand, they are less successful in explaining the extremely high underpricing in emerging markets. Relying solely on firm- and issuing-specific characteristics may yield weak and distorted results because underdeveloped institutional features of the emerging markets would be missed. In China for example, the average underpricing of all IPOs between 1990 and 1993 was 289% according to Mok and Hui (1998), and 178% between 1993 and 1998 according to Chan et al. (2004). Tian (2011) also finds extremely high underpricing of 247% in a sample of 1377 IPOs from 1992 to 2004 and argues that information asymmetry is far from being a major determinant. Similarly, Gao (2010) finds no significant relationship between the initial returns and proxies for information asymmetry, contrary to the classic theories.

With regard to real estate IPOs in particular, Chan et al. (2001) show that US REITs IPOs experience abnormally low underpricing compared to IPOs in other industries. One possible explanation rests in the presence of more individual and fewer institutional investors in REITs than in other industries as this may reduce the impact of informed investors. On the other hand, REITs may also behave more similarly to funds than to operating companies, and they generate low uncertainty leading to a low IPO underpricing (a common characteristic of funds in general). Finally, the characteristics of underlying assets of real estate companies might also represent a further explanation (please refer to Section 2.6 in Chapter 2 for a detailed review). The institutional ownership and fund-like structure characteristics are not represented in Chinese real estate companies because the property market has received enough attention from institutional investors and the majority of companies are operating companies (including developments in their portfolio). As this study presents an analysis of IPO performance from a ‘non-tradable goods perspective’, we believe that Chinese real estate IPOs offer an adequate

laboratory in which to test the relationship between urban economic openness and IPO underpricing.

The final stream of literature relevant to this work is related to globalisation and the linkages between openness and markets of non-tradable goods. Empirical studies find that a country's foreign trade exposure leads to greater productivity growth—see Dollar (1992), Edwards (1998), Miller and Upadhyay (2000) and Sachs and Warner (1995). Following the evidence that productivity is a major determinant of company's profitability—Demsetz (1973), Eilon (1985), Jovanovic (1982), Peltzman (1977) and Stierwald (2010)— Miller and Upadhyay (2000) use a panel data to assess the determinants of total factor productivity. By using a deviation of the classic National Bureau of Economic Research (NBER) calculation of trade openness (total export as a share of GDP), they find a positive effect of trade openness on total productivity. Moreover, in a sample of 29 provinces in China between 1981 and 2005, Jiang (2011) finds that UEO has direct positive effects on Chinese regional productivity growth, consistent with previous country-level studies. In recent years, research has also shown that trade openness has an impact on the financial market development. According to Rajan and Zingales (2003), an increase in both cross-country trades and capital flows leads to an increase in the degree of financial development. Beck (2002), Svaleryd and Vlachos (2002) and Kim et al. (2012) find a reverse causal effect between trade openness and financial development (i.e. the increase in trade openness occurs following an increase in financial development). Finally, Law (2008) and Baltagi et al. (2009) find that trade openness and capital account openness jointly and positively affect financial development in both the banking sector and the stock market. Law (2008), in particular, shows that the effect of trade openness on financial development is greater than that of capital account openness in Malaysia. Moreover, the effect of trade openness is significant in both the banking sector and stock market, while the effect of

capital account openness is less so. By using panel data, Kukeli (2012) finds that trade openness is one of the most important determinants of a country's capital formation.

Within this stream, a group of studies examines the relationship between openness and stock market performance in emerging markets. Li et al. (2004) employ an openness approach to explain the increased firm-specific variation in the 1990s and find that capital market openness positively affects the firm-specific variation while trade openness positively affects the market variation. Basu and Morey (2005) argue that, once a country opens up its trade to the world, stock prices start to follow a random path whilst they were serially correlated beforehand. Following an increase in trade openness, the development in technology will be captured by stock prices in equilibrium leading to a decrease in excess returns and, eventually, an increase in stock market efficiency. Lim and Kim (2011) show that trade openness boosts firms' future profitability and reduces uncertainty. As a result, investors react faster to the information on the market. Therefore, the trade openness finally enhances the informational efficiency of the stock market. However, they also find that the *de facto* measure, i.e. classic NBER measure, has a significantly negative impact on stock return serial correlations, but the alternative *de jure* measure, i.e. a country's international trade freedom index constructed according to a country's trade policy, does not show any significance. As the *de facto* measure reflects real output and there is no *de jure* measure at city level in China, we use the *de facto* measure in the following empirical analysis.

Being the biggest asset of the non-tradable goods market, real estate and its links with trade openness have also been explored. Initially, Bardhan et al. (2004) empirically test the relationship between trade openness and real estate rents using monthly data for 46 countries. For the measurement of openness, standard NBER indices are used. Results show that wage levels, population, and trade openness positively affect rents, supporting the Balassa-Samuelson effect. This research has then been extended to a regional level study by Wang et al. (2011)

who analyse trade openness and real estate prices at the urban level. The study focuses on China, as it represents a good example of an emerging market with an urbanization rate increasing from 30% in 1998 to 46% in 2008. With a sample covering 35 cities from 1998 to 2006, they find that real estate prices increase by 2.82% when UEO increases by 10%. To appreciate its importance, between 1998 and 2006, 16% of the increase in Chinese real estate prices is attributed to the increase of UEO alone. Bardhan et al. (2008) then examine the effects of country-level trade openness on the returns of securitized real estate by using a sample of 946 listed real estate companies from 16 countries. They find that trade openness has a significantly negative impact on the excess returns of real estate stocks, controlling for global and domestic variables. Case et al. (1999) point out that even though country-level factors are driving real estate performance, regional output is a more important determinant.

4.3 Data and Methodology

The sample in this study includes IPOs of Chinese real estate companies from 1992 to 2013. The Shanghai Stock Exchange was founded in 1990 and the Shenzhen Stock Exchange was founded in 1991. So, our sample traces back to almost the very beginning of the stock markets in China in order to capture the changes in IPO performance throughout the economic cycles. The main IPO data is obtained from Thomson One New Issues Database. Due to the incomplete records of Chinese IPOs, especially those in the early years of our sample, most data have been manually collected from various local sources, such as the websites of Shanghai Stock Exchange, Shenzhen Stock Exchange, Hong Kong Stock Exchange, Singapore Stock Exchange, as well as financial websites (e.g. jrj.com and sina.com). Firm-specific data (e.g. age, state ownership, land reserves, income and real estate assets) are manually extracted from the issuers' IPO prospectus, which are obtained from different sources including Thomson One, the Hong Kong Exchange HKExnews (a designated website providing regulatory filings and disclosure of listed companies) and companies' websites (with the majority of prospectuses

being in Chinese). Economic data (e.g. foreign trade volume and GDP) is extracted from the City Annual Statistical Reports, obtained from the China National Knowledge Infrastructure (CNKI) database. City Annual Statistical Reports are the official annual governmental reports of the local annual economic performance. CNKI is a key national e-publishing project in China that was started in 1996, approved by the Press and Publications Administration of the People's Republic of China (PRC) and backed by Tsinghua University.

In total, there are more than 150 listed Chinese real estate companies in the database. However, some of them were not predominantly real estate companies when they went public and some others went public through a 'back-door listing', whereby the company goes public by acquiring an already publicly listed company. Hence, there are 70 IPOs meeting the selection criteria of being listed as a real estate IPO and having the full set of information for all the variables of interest.[24]

The dependent variable (IR_i) represents the initial return of company i, and is measured as in Equation 1 in Chapter 3. Again, the market return is negligible compared to the level of underpricing and we do not adjust for it in line with most of the empirical studies in the literature. We also estimate models with the market-adjusted measure but results do not change and hence we do not report them.

The main variable of interest is urban economic openness *(UEO)*, which is measured by the city-level trade openness. As discussed above, we adopt the *de facto* measure by NBRE, which is computed as the sum of imports and exports as a percentage of GDP. Since most studies focus on a country-level analysis and use the NBER definition, we adjust the formula

[24] As we mentioned above, we focus on real estate IPOs as a testing laboratory because other industries hardly show a localised business and a regional composition of the investment portfolio is not available. This is the reason why we cannot extend our sample to other industries or form a control sample to test the impact of UEO at firm level.

as required by our single country study to compute the city-level measure by using total annual imports and exports between city j and its foreign counterparties and the city's annual GDP.

$$UEO_j = \frac{Imports_j + Exports_j}{GDP_j} \quad \text{Equation 8}$$

The amount of foreign trade of a city is recorded in the City Annual Statistical Reports by the local government and is expressed in U.S. dollars. The total sum of imports and exports is converted into Chinese Yuan (RMB) by using the average annual U.S. Dollar to Chinese Yuan exchange rate in the same year.

Most Chinese real estate companies focus their businesses in one area—usually one city—while some of them have businesses in several cities (often geographically close). Only a very few big real estate companies run businesses widely spread across China, mainly focusing on big developed cities such as Shanghai or Beijing. As these big cities usually share a similar level of trade openness, this should not affect the estimation results. For companies operating in more than one city, we obtain the UEO measure for a given company as the weighted average of the individual UEO measures of the cities in which the company holds real estate investments (UEO_{ji}). The weights are constructed as the ratio between the available land with land-use rights company i has in city j ($Land_{ji}$) and the overall land with land-use rights company i owns ($Land_i$). The information regarding the locations of investments for each company and the land-use rights are manually extracted from IPO prospectuses and the financial reports before IPO. The *UEO* for company i is then computed as follows:

$$UEO_i = \frac{1}{Land_i} \sum_{j=1}^{m} [UEO_{ji} \times Land_{ji}] \quad \text{Equation 9}$$

The pie chart of Figure 1 is to better show the regional pattern of the real estate business in China. We can see that 50% of companies in the sample operate real estate assets locally in one city. The *UEO* for these companies does not require weighting and is simply the annual city-level foreign trade as a share of the annual city-level GDP. For the remaining companies, the majority is based in two different cities and 21% of companies have more than 50% and less than 100% of their businesses focused in one city. Overall, 90% of companies in our sample locate at least 30% of their businesses in one city. As a robustness check, we also split the sample into companies operating in one city and companies operating in more than one city. Separate estimations are run and no significant difference is found. Therefore, we present and discuss only the results obtained with the overall sample.

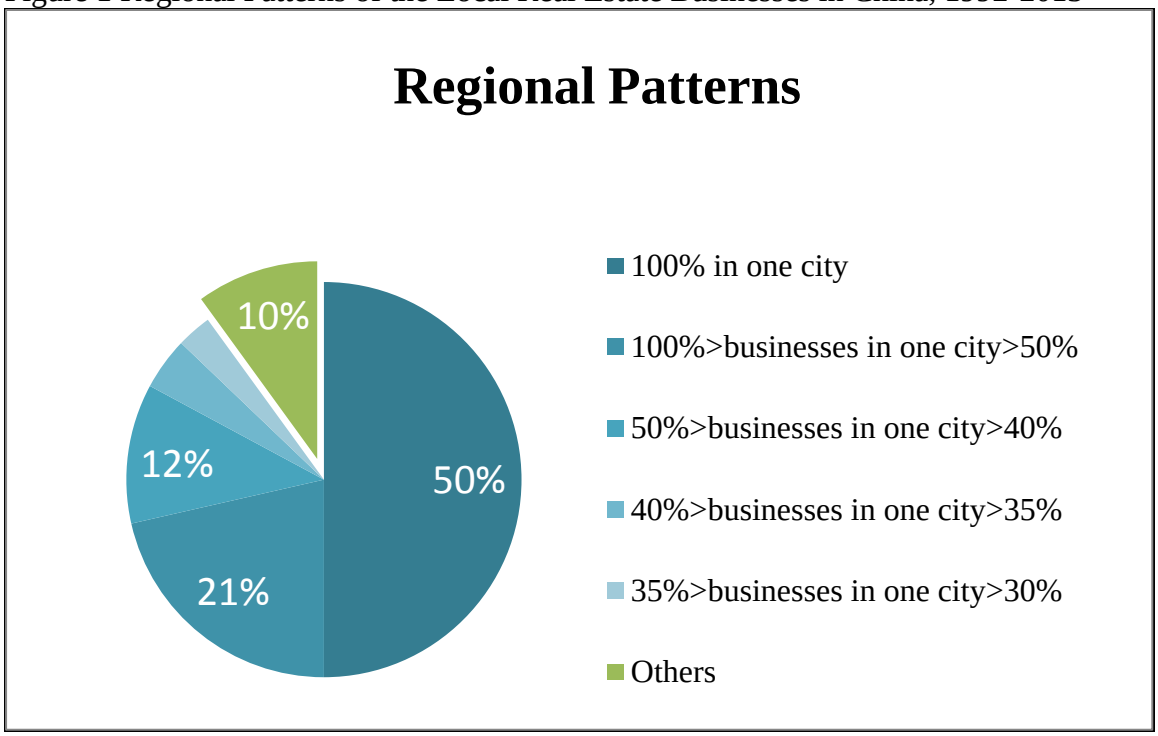
In the remaining part of this section we present other variables normally included in related works and used here as control variables:

LNLAG is the natural logarithm of the time lag between the IPO issuing and listing dates. According to the information-asymmetry-based theories discussed in Section 2.3, the longer the time lag is, the higher the underpricing is due to the increased uncertainty. Therefore, we expect a positive relationship between *LNLAG* and underpricing. The issuing dates are extracted from the prospectus and the listing dates are taken from the stock exchanges.

LSIZE is the same measure of firm size used in Chapter 3, which captures the ex-ante uncertainty about IPO company. As there is usually lower uncertainty associated with larger companies, we expect a negative relationship between the firm size and underpricing.

ROREA measures the return on real estate assets for the year preceding the IPO. The return on assets (ROA) has often been used to examine the effect of a company's earnings performance prior to the IPO on its IPO valuation. To better capture the real estate characteristic, we use the return on real estate assets instead. The earnings from the real estate business are usually reported separately in the prospectus. The data of the real estate asset size for each company is manually collected and computed as the sum of the accounts of property, plant and equipment, investment properties, prepayment for the rent of the land and property, property held for sale, property under development and land reserves in the financial report before the IPO.

Figure 1 Regional Patterns of the Local Real Estate Businesses in China, 1992-2013



LNAGE is the natural logarithm of the firm age, i.e. time (years) elapsed between its foundation and the IPO dates. It is also a proxy for the level of uncertainty about the IPO valuation. As there is more information available about a long-established company, we expect a negative relationship between firm age and underpricing.

STATEO is a dummy variable denoting state ownership. It equals 1 if the real estate company is state-owned before the IPO and 0 otherwise. It is commonly used in Chinese IPO studies as it reflects the influence of the special political system.

CHINA is a dummy variable denoting the IPO location. It equals 1 if the company is listed in Mainland China, 0 otherwise. Note that in our study we refer to Chinese real estate companies as listed real estate companies whose businesses are in Mainland China, even if some of them might decide not to be listed on stock exchanges in Mainland China. In our sample, 33 companies were listed in Mainland China, 35 in Hong Kong and 2 in Singapore. According to Wong et al. (2013a), Chinese real estate companies going public in Hong Kong experience much less underpricing than those listed in Mainland China due to a better market transparency and corporate governance reducing the information asymmetry.

MR30 and *MR60* represent the market performance in the 30 and 60 days before the IPO. 30-day pre-IPO market return is commonly used to proxy for market sentiment prior to an IPO. To quickly revisit, the behavioural arguments believe that the market momentum reflects the investor sentiment and causes aftermarket investor-driven high initial returns. *MR30* is essentially the same measure as *MRETURN* in Chapter 3. The findings in Chapter 3 suggest a positive relationship between the 30-day market return prior to the IPO and the IPO underpricing, consistent with most of the empirical studies. However, an alternative measure—60-day market return prior to the IPO—is also included in this study. As the Chinese stock market is far from being mature and there are many 'noise' traders, it is reasonable to expect that market momentum is likely to last longer.[25]

DAY30 and *DAY60* represent the numbers of other IPOs within the 30- or 60-day period preceding the IPO as shares of the total numbers of IPOs during the sample period, a proxy for

[25] If the market is less efficient, the time that investors need to adjust their *a priori* assumptions is longer.

the IPO volume. *DAY30* is the same measure as *VOLUME* in Chapter 3 and *DAY60* is included for the same rationale behind *MR60*.

Table 10 contains the description and summary statistics of the main variables. Chinese real estate IPOs are strongly underpriced with an average initial return of 103.85% over our sample period. There is also a significant variation in initial returns, with values ranging from -7.3% to 980%, consistent with previous studies. As expected, *UEO* differs significantly across companies, ranging between 3.06% and 551.8%. This implies the existence of significant heterogeneity in the level of trade openness across Chinese cities. The variation comes from exports and imports with foreign countries, while city-level GDP growth rates usually follow the country-level figures very closely and show a greater homogeneous pattern across cities.

The state ownership of the issuing company has been a popular approach to explain the extreme IPO initial returns in China. The political system in China is different from that in developed countries and there exists strong government intervention in the financial market. Therefore, researchers argue that state ownership represents a negative signal of a firm's independent governance, indicating low transparency due to a higher possibility of manipulation and corruption within the firm. Therefore, state-owned companies are expected to experience higher underpricing than privately owned ones. Following this argument, we summarize our data by state ownership. The first two rows in Panel B of Table 10 report the statistics of IPOs of state-owned and non-state-owned companies. Consistent with the arguments above, the average IPO initial return, standard deviation and interval of non-state-owned companies is much smaller than the ones of state-owned companies. Wong et al. (2013a) study the influence of IPO location on IPO underpricing of Chinese developers, arguing that the IPO location (Mainland China vs Hong Kong) represents a signal for developers' quality and levels of transparency. Since our sample includes developers as well as investors, we have access to firms listed in three different stock exchanges: Mainland China (35 companies), Hong

Kong (33 companies), and Singapore (2 companies only). The last two rows in Panel B of Table 10 report the statistics of initial returns by IPO location. Our results are consistent with the findings by Wong et al. (2013) as the initial returns of the IPOs listed in Mainland China are indeed much higher than those listed outside.[26]

However, since the state-ownership and IPO location variables are highly correlated (0.72) as they may proxy for the same factor (i.e. companies listed in Mainland China tend to have state ownership while companies listed outside tend to be privately owned), we decide to use them alternatively in our estimations and we explain the listing preference of different ownership structures as follows: stated-owned companies are more likely to choose to be listed in Mainland China because they can use their political connections more efficiently than in other countries/markets, while private companies try to avoid the political manipulation in Mainland China and choose more competitive and transparent markets like Hong Kong and Singapore. As a robustness check, we also estimate the model including both variables and the results for the variable of interest (*UEO*) do not change significantly, hence we do not report them.

Although a large number of empirical studies support the negative relationship between the underwriters' reputation and the level of IPO underpricing, the reversed relationship has also been documented not only in the U.S. market but also in other developed markets, as discussed in Chapter 2.

If we consider Chinese IPOs where the market is far more exposed to the political system, the role of the underwriters' reputation seems to be less significant. The special regime in China and its constant-changing nature means that the underwriting process cannot be treated

[26] As there are only two IPOs listed in Singapore and the previous literature controls for the negative effects associated with the Chinese government and the undeveloped nature of the market, we decided to differentiate between Mainland China and non. However, we have also estimated models with a sample excluding the two IPOs listed in Singapore and the results do not change.

exactly the same as in western countries. The striking difference is the intervention from the government on the IPO market, which has only begun to die down after the late 2000s. The intervention mainly exists in two ways. Firstly, the central government controls the supply of IPOs by restricting the quota of IPOs in each province or municipal area, leading to a short supply given the high demand from investors. Secondly, the government had always set a restriction on the IPO offer price in reference to either the book value or the P/E ratio of the issuing company. From 2005, China has started to populate the bookbuilding method with an aim to bring down the extremely high underpricing. However, even after a decade, the bookbuilding process today is still not fully market-driven and constantly influenced by the changing government policies and market reforms.

While the majority of IPO studies in China have ignored the underwriters' influence, Su and Bangassa (2011) follow the classic theories to systematically examine the effects of the underwriters' reputation on IPO underpricing in China and find little influence. Despite the lack of information on Chinese investment banks, unlike Stoll and Curley (1970) and many other studies on underwriters' reputation, the sample in this study includes IPOs from more than one market, with IPOs listed in Mainland China often using Chinese investment banks and those listed in Hong Kong and Singapore often using international investment banks. This nature makes the ranking of the underwriters difficult and means that the measurement of reputation very much correlated with state ownership and the dummy on the IPO location. Hence, we do not include this variable in our study.[27] According to the above studies, we believe that this does not affect the tests on the hypothesis.

[27] This also represents a reason why cross-country studies do not normally control for underwriters' reputation.

4.4 Results and Robustness Tests

4.4.1 Ordinary Least Squares (OLS) Estimations

We first test to what extent *UEO* affects IPO underpricing by using an ordinary least squares (OLS) regression. The specification is as follows:

$$IR_i = \beta_0 + \beta_{UEO} \times UEO_i + \beta_i \times X_i + \varepsilon_i \qquad \text{Equation 10}$$

where X_i is a vector of other explanatory variables and β_i are the coefficients to be estimated. Firstly, we check for homoscedastic error terms by using the Breusch-Pagan test. As we reject the null hypothesis that the variance of the error term is constant across observations, the standard errors presented below the coefficients are corrected for heteroscedasticity.

Table 10 Variables Description: Firm-, Issuing- and Macroeconomic Factors (Chapter 4)
Panel A: Variable Definition

Variable	Description	Statistics			
		Mean	StD	Min	Max
IR	Initial Return (%): difference between the offer price and the closing price of the first trading day	103.85	167.47	-7.23	980
UEO	Urban Economic Openness (%): total import and export as a percentage of GDP at city level, weighted by the land-use right that a company owns in one city as a share of its overall land-use right (NBER approach)	98.63	90.71	3.06	551.8
LNLAG	Time Lag: time difference between issuing and listing dates	3.62	1.24	1.39	6.4
LSIZE	Natural Logarithm of Total Proceeds of the IPO	6.52	1.49	2.89	9.47
ROREA	Return on Real Estate Asset (%): ratio between income from the real estate businesses and the value of real estate assets	63.39	106.11	8.4	713.87
LNAGE	Natural Logarithm of Firm Age (years between incorporation and IPO date)	2.29	0.53	0.69	3.04
STATEO	State Ownership: dummy variable that equals 1 if it is state-owned and 0 otherwise	0.41	0.5	0	1
CHINA	IPO Location: dummy variable that equals 1 if the company is listed in Mainland China and 0 otherwise	0.47	0.5	0	1
MR30	Market performance in the 30 days before the IPO	2.01	13.32	-28.74	37.06
MR60	Market performance in the 60 days before the IPO	5.87	20.83	-36.01	90.64
DAY30	Number of IPOs within the 30 days before the IPO as a share of all the IPOs across sample period	16.57	12.78	0	51
DAY60	Number of IPOs within the 60 days before the IPO as a share of all the IPOs across sample period	33.90	24.16	3	96

Panel B: Initial Returns for IPOs: State- vs. Non-state-owned and Listed in vs outside Mainland China

Variable	Mean	StD	Min	Max
State ownership	216.39	206.89	-7.23	980
Non-state ownership	24.25	52.36	-5.81	292.89
Mainland China	211.7	193.98	7.14	980
Outside Mainland China	7.66	11.78	-7.23	42.86

Table 11 UEO and IPO Underpricing (OLS)

Dependent Variable ***Underpricing***	**A1**	**A2**	**B1**	**B2**
UEO	-0.256**	-0.299**	-0.273**	-0.308**
	-2.05	-2.35	-2.13	-2.42
LNLAG	44.573***	49.076***	35.356***	39.792***
	2.76	3.06	2.79	3.27
LSIZE	-45.863**	-34.772*	-44.582**	-33.790*
	-2.55	-1.70	-2.65	-1.81
ROREA	0.299*	0.279*	0.264	0.242
	1.76	1.74	1.38	1.32
LNAGE	-14.287	-15.796	-15.470	-16.912
	-0.50	-0.55	-0.56	-0.62
STATEO	78.967**		71.735**	
	2.48		2.26	
CHINA		109.131***		104.665***
		2.67		2.78
MR30	3.049*	2.910		
	1.79	1.61		
DAY30	-1.236	-1.313		
	-1.33	-1.47		
MR60			2.574***	2.542***
			3.10	2.95
DAY60			-1.062*	-0.994*
			-2.00	-1.86
Constant	261.959***	165.063	303.102***	203.061*
	2.90	1.47	3.04	1.71
Observations	70	70	70	70
Adj R-squared	0.567	0.592	0.619	0.645

This table presents the Ordinary Least Squares estimation for a cross-section of Chinese real estate IPOs that have taken place between 1992 and 2013. Group A regressions control for the 30-day market return and IPO numbers prior to the IPO while group B regression controls for the 60-day variables. The dependent variable is *Underpricing* which is the initial return between the first-trading day closing price and the IPO offer price, expressed as a percentage. *UEO* is the weighted average of the urban economic openness which is the sum of the city-level imports and exports as a share of this city's GDP. The land-use right that a company owns in one city as a share of its overall land-use right is used as the weight. *LNLAG* is the natural logarithm of the time lag between issuing and listing dates. *LSIZE* is the natural logarithm of the IPO proceeds. *ROREA* is the return on the real estate assets of a company. *LNAGE* is the natural logarithm of the period of time for which the firm has been running as a real estate company before the IPO. *STATEO* is equal to 1 if the company is state-owned, 0 otherwise. *CHINA* is equal to 1 of the company is listed in Mainland China, 0 otherwise. *MR30* and *MR60* are 30- and 60-day market returns prior to the IPO. *DAY30* and *DAY60* are the numbers of IPOs which have taken place 30 or 60 days prior to the IPO as a share of all the IPOs across sample period respectively. t-statistics are in parentheses. ***, **, * denote significance at 1%, 5% or 10% respectively.

Table 12 State Ownership vs IPO Location and Variance Inflation Factors

Panel A: Chow Test				
	A1	A2	B1	B2
Prob > F				
STATEO	0.5724		0.4046	
CHINA		0.9239		0.3117

Panel B: Variance Inflation Factors (VIF)				
	A1	A2	B1	B2
UEO	1.25	1.27	1.25	1.27
LNLAG	1.15	1.09	1.15	1.10
LSIZE	1.56	1.98	1.55	1.94
ROREA	1.10	1.10	1.11	1.11
LNAGE	1.31	1.31	1.31	1.30
STATEO	1.71		1.67	
CHINA		1.98		1.98
MR30	1.07	1.07		
DAY30	1.28	1.23		
MR60			1.07	1.06
DAY60			1.27	1.25
Mean VIF	1.30	1.38	1.30	1.38

The main results are presented in Table 11, which includes two sets of OLS regressions—Group A (A1 and A2) controls for 30-day market variables and Group B controls (B1 and B2) for 60-day market variables. As expected, the coefficients for urban economic openness are negative throughout all specifications and they are significant at the 5% level. A 10% increase in the UEO results in a 2.56% to 3.16% decrease of IPO initial returns depending upon the specifications. This supports our research hypothesis that real estate companies with investments in more trade-open areas have less incentive to underprice their IPOs. Holding other factors constant, a real estate company would experience 2.56% to 3.08% less IPO underpricing if it runs its real estate businesses in a city where the level of trade with foreign

countries is 10% higher. The greater regional trade openness increases the future profitability and reduces the valuation uncertainty, a key determinant of the level of IPO underpricing. According to the Balassa-Samuelson effect, trade openness will eventually increase the prices of non-tradable products including real estate assets. Besides, trade openness positively affects productivity which is an important determinant of a company's profitability. In addition, the demand for real estate could rise as a direct consequence of the increase in foreign and domestic investments into real estate, given an improvement in capital flows. Therefore, investors in companies operating in areas with higher UEO tend to be more confident about the local real estate market and the company's future profitability, which leads to less uncertainty about the company's valuation. As a result, issuers will have less incentive to underprice the IPO shares.

Consistent with the majority of IPO studies, we find that the time lag between issuing and listing dates (*LNLAG*) positively affects the initial returns of IPOs, i.e. the longer it takes to reach the listing after the issuing date, the more uncertainty and the higher IPO underpricing we expect. As the time lag is log-transformed, holding other explanatory variables constant, the expected return difference of an IPO between two periods in time (t_1, t_2) is represented as follows:

$$IR_{i,1} - IR_{i,2} = \beta_{LNLAG} \times [\ln(t_1) - \ln(t_2)] = \beta_{LNLAG} \times \ln(\frac{t_1}{t_2}) \quad \text{Equation 11}$$

From Equation 11 it becomes clear that the relative change of the time lag affects the initial returns regardless of the baseline of time. If β_{LNLAGA} is equal to 44.573 as shown in specification A1, then a 10% increase in the time gap between the issuance and the listing (around 4 days considering the average time of 37 days—see Table 10) will result in a 4.25% increase in the underpricing.

Unlike some of the previous Chinese IPO studies, the results in this table are in line with the information asymmetry theory: the larger the firm, the smaller the uncertainty and therefore the lower the underpricing. The coefficients on *LSIZE* are significant throughout all regressions at 95% or 90% confidence level. In specification A1, a 10% increase in the proceeds leads to a 4.37% decrease in IPO underpricing. Interestingly, we find that the return on real estate assets (*ROREA*) positively affects the IPO underpricing at a 10% significant level (see specification A1 and A2), with a 2.79% to 2.99% increase in the IPO initial returns when *ROREA* increases by 10%. In fact, when the return on real estate assets of an IPO company is relatively high, investors read this information as a signal of 'good' firm quality and hence they are more willing to participate in the IPO with a higher after-market bidding price.

Contrary to previous research in developed countries, we also find no significant relationship between the firm age and the underpricing, hence once again indicating that the classic information asymmetry theory may be weakened by the more 'immature' Chinese market, supporting Gao (2010) and Tian (2011).

Models A1 and B1 include state ownership (*STATEO*) and control for 30-day and 60-day pre-IPO market conditions respectively. The coefficients for state ownership are both significant and positive suggesting that state-owned companies experience significantly higher IPO underpricing than private companies. This is consistent with the majority of Chinese IPO studies which blame the extremely high underpricing on the political connections and government interventions—see Tian (2011). For example, Chan et al. (2004) find that the state ownership, including government and legal entity ownership, is positively related to IPO underpricing. Chang et al. (2008) argue that the Chinese government decides the IPO supply and sets the price-to-income limit for offering shares, with both regulations leading to a high level of underpricing. With regard to post-IPO stock returns, Fan et al. (2007) show that companies with more political connections actually underperform those which are loosely

connected. Specifications A2 and B2 include the IPO location (*China*) instead of state ownership status and coefficients are significantly positive, consistent with Wong et al. (2013a), where listing in Mainland China (i.e. market less transparent) leads to a much higher underpricing.

Consistent with the behavioural arguments, we find that investor sentiment (proxied by market returns) positively affects the IPO initial returns. When we pass from a 30- to 60-day period, the coefficient becomes more significant (99% in model B1 from 90% in model A1) and hence we find support for the assumption about the weak efficiency of Chinese markets and that the 60-day market return is a better measure. The number of IPOs during the period preceding the IPO listing date show a negative effect on IPO underpricing for both periods (30 and 60 days), but the coefficient is only significant when a 60-day window is used, supporting Altı (2005) who argues that the unknown common factor about IPO valuation will be revealed by previous IPOs, resulting in less underpricing. Note that the results on market variables are also similar to those presented in Chapter 3.

Furthermore, consistent with Wong et al. (2013a), we find a significant impact of the listing location (*CHINA*) on IPO initial returns. Companies listed in Mainland China experience significantly higher IPO underpricing than those listed in Hong Kong or Singapore. Wong et al. (2013a) argue that low underpricing is a form of reward to a company who chooses to go public in a more competitive, yet more informationally transparent, market and it signals 'good' firm quality. It could then be argued that the characteristics of companies listed in Mainland China (*a*) are systematically different from those listed outside (*b*). The same argument may be applied to the ownership structure of state-owned (*a*) versus private (*b*) companies. Hence, we investigate the need to estimate separate models by using a Chow test. Firstly, we split the sample by IPO location or state ownership, and estimate the two following regressions:

$$IR_{i,a} = \beta_{0,a} + \beta_{UEO,a} \times UEO_{i,a} + \beta_{i,a} \times X_{i,a} + \varepsilon_{i,a} \quad if \frac{CHINA}{STATEO} = 1 \qquad \text{Equation 12}$$

$$IR_{i,b} = \beta_{0,b} + \beta_{UEO,b} \times UEO_{i,b} + \beta_{i,b} \times X_{i,b} + \varepsilon_{i,b} \quad if \frac{CHINA}{STATEO} \neq 1 \qquad \text{Equation 13}$$

Secondly, we compare these results with the ones obtained estimating the pooled model from Equation 10, which assumes that the coefficients are the same across the two groups. The Chow statistic is the output of an F-Test comparing the difference between the above coefficients:

$$F = \frac{RSS_{pooled} - (RSS_a + RSS_b)}{RSS_a + RSS_b} \times \frac{n - 2k}{k} \sim F(k, n - 2k) \qquad \text{Equation 14}$$

where $RSS = \sum_i^N \varepsilon_i^2$ is the residual sum of the squares, i.e. the variation unexplained by the regression model[28]. Results reported in Panel A,
Table 12, indicate that we do not need to separate the sample in both cases.

4.4.2 Two Stage Least Squares (2SLS) Estimations

Since *UEO* is a company-level variable constructed by using macroeconomic factors (trade openness of Chinese cities), it is reasonable to check that it is not correlated with other unobserved economic factors which might also affect the individual IPO performance. In fact, if *UEO* is correlated with the error term ε in Equation 10, the exogeneity assumption of OLS

[28] If the difference in the combined residual sum of the squares of the two separate models and the residual sum of the squares of the pooled model is significant, we should then consider estimating the model separately by IPO location.

estimators is violated and we are presented with an omitted variable bias. As a result, the OLS estimation would be inconsistent with:

$$E[\beta|X] = \beta + X'X^{-1}X'\varepsilon \neq \beta \quad \text{Equation 15}$$

A common method to correct for endogeneity is the use of instrumental variables (IVs), which are correlated with the endogenous variable (*UEO* in this case) but uncorrelated with the error term ε. Previous studies find a significant relationship between the exchange rate volatility and foreign trade volumes. However, Gu and Gao (2007) find that the exchange rate volatility does not significantly affect foreign trade volume in China because, being a developing country, trades may be mainly driven by domestic demand. Hence we expect disposable household income to have a positive relationship with the trade volumes, which is unlikely to be related with IPO initial returns. Therefore, we use the natural logarithm of disposable household income per capita (*LNDINC*) as an instrument for *UEO* in the estimation. As a robustness check, we also use a second instrument to create an over-identified case and find that results do not change (see details in the following robustness check section).

The regional disposable household income per capita is collected from the City Annual Statistical Reports. We use a two stage least squares estimation (2SLS). In the first stage, we estimate the predictions of the endogenous variable *UEO* by using the instrumental variable:

$$UEO = \delta_0 + \delta_1 x_1 + \cdots + \delta_{k-1} x_{k-1} + \theta LNDINC + v_{UEO} \quad \text{Equation 16}$$

In the second stage, fitted values of *UEO* are used to replace the actual regressor and the following model is estimated:

$$IR = \alpha_0 + \alpha_1 + \cdots + \alpha_{k-1}x_{k-1} + \lambda LNDINC + \eta \qquad \text{Equation 17}$$

$$\eta = \varepsilon + \beta_{UEO}v_{UEO};\ \alpha_j = \beta_j + \beta_{UEO}\delta_j;\ \lambda = \beta_{UEO}\theta$$

Results on the 2SLS estimations are presented in Table 13. They show that the effect of UEO on IPO initial returns remains negative and significant throughout the different specifications, with significance levels reduced to 10% and impact enlarged. A 10% increase in UEO leads to a decrease between 10.50% and 20.40% in IPO underpricing. As expected, the efficiency in a 2SLS specification is reduced while standard errors are not significantly different from OLS models. The effect of the time lag remains positive and strongly significant and the 60-day pre-IPO market performance is still preferred to a 30-day market return. Durbin and Wu-Hausman estimates—which include the estimated error term from the first stage in the 2SLS estimation as an additional variable—are performed to test for the endogeneity of UEO. Under the null hypothesis that all the variables are exogenous, the coefficients on the error term from the first stage should be insignificant in the Durbin and Wu-Hausman tests (otherwise, we should reject the null hypothesis and treat UEO as endogenous). The Durbin and Wu-Hausman tests are performed for each 2SLS regression and statistics are reported at the bottom of Table 13. Apart from the Wu-Hausman statistic in regression D2 (with IPO location and 60-day market variables), all other statistics are significant at least at a 90% confidence level, suggesting that we indeed need to treat *UEO* as endogenous.

Table 13 : UEO and IPO Underpricing (2SLS)

Dependent Variable ***Underpricing***	**C1**	**C2**	**D1**	**D2**
UEO	-2.040*	-1.217**	-1.792*	-1.050*
	-1.75	-2.05	-1.72	-1.90
LNLAG	54.500***	55.895***	46.675***	46.922***
	2.80	4.21	2.60	3.79
LSIZE	-24.480	-19.456	-26.855	-22.228
	-1.09	-1.15	-1.37	-1.49
ROREA	0.244	0.242	0.212	0.212
	1.14	1.62	1.12	1.59
LNAGE	-95.460	-57.441	-84.495	-50.399
	-1.37	-1.39	-1.37	-1.34
STATEO	141.700**		126.483**	
	2.06		2.07	
CHINA		153.207***		138.356***
		3.07		3.12
MR30	1.399	2.020		
	0.18	1.58		
DAY30	-3.986	-2.732*		
	-1.55	-1.75		
MR60			1.896*	2.213***
			1.83	3.17
DAY60			-2.355*	-1.611**
			-1.92	-2.13
Constant	472.800**	232.299*	481.101***	259.749**
	2.30	1.81	2.65	2.23
Durbin (score) chi2(1)	7.2886	4.0682	5.8687	2.7783
	(p = 0.0069)	(p = 0.0437)	(p = 0.0154)	(p = 0.0956)
Wu-Hausman F(1,60)	6.9735	3.7022	5.4907	2.4798
	(p = 0.0105)	(p = 0.0591)	(p = 0.0225)	(p = 0.1206)

This table presents 2SLS estimation with one instrument, where group C regressions control for the 30-day market return and 30-day IPO numbers prior to the IPO while group D regressions control for the 60-day variables. The dependent variable is *Underpricing* which is the initial return between the first-trading day closing price and the IPO offering price, expressed as a percentage. *UEO* is the weighted average of the urban economic openness which is the sum of the city-level imports and exports as a share of this city's GDP. The land-use right that a company owns in one city as a share of its overall land-use right is used as the weight. The instrumental variable for *UEO* is the natural logarithm of the disposable household income per capita (*LNDINC*). *LNLAG* is the natural logarithm of the time lag between issuing and listing dates. *LSIZE* is the natural logarithm of the IPO proceeds. *ROREA* is the return on real estate assets of a company. *LNAGE* is the natural logarithm of the period of time for which it has been running as a real estate company before the IPO. *STATEO* is equal to 1 if the company is state-owned, 0 otherwise. *CHINA* is equal to 1 of the company is listed in Mainland China, 0 otherwise. *MR30* and *MR60* are 30- and 60-day market return before the IPO. *DAY30* and *DAY60* are the numbers of IPOs which have taken place 30 or 60 days prior to the IPO as a share of all the IPOs across the sample period respectively. Z-statistics are in parentheses for 2SLS regressions. ***, **, * denote significance at 1%, 5% or 10% respectively.

Table 14 First-stage Regression of 2SLS

Model:	**C1**	**C2**	**D1**	**D2**
LNDINC Coef.	44.7867	67.0882	44.3146	64.3094
P-value	0.076	0.013	0.08	0.018
R-squared	0.2408	0.2917	0.2400	0.2798
F test	3.2474	6.5615	3.1755	5.9370
Prob > F	0.0765	0.0129	0.0797	0.0178

As there is no clear definition of or test for the weakness of an instrument, we at least report the results of the first-stage regression (Table 14), where the statistical significance of the instrumental variable that is used to explain the endogenous variable (*UEO*) is reported. The coefficients of *LNDINC* are significant throughout the four specifications, confirming a positive relationship between the disposable household income per capita and *UEO*. The R-squared is between 0.24 and 0.29 while the *F* statistic ranges from 3.25 to 6.56. However, it is noted that the *F*-test strongly relies on the number of endogenous variables and the number of instruments so that the more additional valid instruments used, the greater the *F* statistic of the joint significance of the instruments will be. Overall, the results suggest that the chosen instrument is appropriate for the model.

4.4.3 Robustness Tests

Multicollinearity

In cross-sectional studies, variance inflation factors (VIF) are usually calculated to test for the presence of multicollinearity, which could lead to biased estimators. We report the VIFs

of our estimations in Panel B of Table 12. Following Chatterjee and Hadi (2006)[29], since no VIF is larger than 10 and the average is not considerably larger than 1, we conclude that the estimation is not significantly affected by multicollinearity.

Urban Economic Openness vs. Wider Economy

As economic variables are usually highly correlated with each other, there may be concerns that the significant impact of *UEO* is actually associated with economic factors other than regional trade openness. Therefore, we control for the effect of the wider economy to determine whether foreign trade openness rather than the overall economic performance affects IPO underpricing. China is a developing country that has maintained a fast rate of economic growth for the last three decades and the difference in the GDP growth rates across regions and time is very small. Therefore, GDP levels instead of growth rates are used as they potentially capture other effects such as the size of the region or the developing scale. Since the city-level GDP also includes foreign trade volumes, we deduct the net exports from the local GDP to exclude the foreign trade contribution and take the natural logarithm form of it (*LNNGDP*). Once we obtain this measure at the city level, we then compute a weighted average to obtain the measure at company level following the same procedure used for *UEO*. As state ownership (*STATEO*) and IPO location (*CHINA*) can be considered alternative proxies and show similar results, in this part of robustness checks only results including state ownership are reported. Firstly, we use *LNNGDP* to replace *UEO* in the OLS regressions to estimate the impact of net regional GDP on IPO underpricing (columns E1 and E2 in Table 15), with Group 1 and 2 controlling for 30- and 60-day market variables respectively.

[29] They show that multicollinearity exists when there are VIFs larger than 10 and the average of all VIFs is larger than 1. The majority of the literature also argues that collinearity only starts to become an issue when there is a VIF larger than 30.

Table 15 shows that, in support of our expectation, the coefficients of *LNNGP* are negative but the relationship with IPO initial returns is not significant—with all other coefficients being similar to the results in Table 11. As *LNNGDP* excludes foreign trade, the correlation with *UEO* is low (0.11) and we therefore estimate an OLS model including both *UEO* and *LNNGDP* (F1 and F2). Coefficients and statistical significance of *UEO* are similar to the ones obtained in the baseline regressions (A1 and B1 in Table 11) and the net GDP is still not significant. This finding confirms that it is the regional trade openness rather than the wider economy which affects IPO underpricing of Chinese real estate companies. Finally, we estimate a 2SLS model controlling for *LNNGDP*. Compared to baseline models (C1 and D1 in Table 13), results still hold. The economic effect of *UEO* is even stronger and the efficiency is improved (95% confidence level in both models G1 and G2), while we find no significant effect of *LNNGDP* on IPO initial returns, further confirming the robustness of the results.

Market Changes and Time Dummies

This study includes real estate IPOs from 1992 to 2013, which was a dynamic period during which the Chinese market underwent several stock market reforms. Therefore, it is reasonable to consider whether the relationship between *UEO* and real estate IPO underpricing has changed and whether the results remain robust. To control for the general changes in the Chinese market, we create four time dummies, each covering a five-year period (results presented in Table 16). With this approach, we only use four additional variables instead of 21 year dummies and this allows us to save some degrees of freedom—very important considering the small sample size. This approach also seems reasonable because macroeconomic variables already reflect time variation and hence changes in the market dynamic.

Table 15 UEO and IPO Underpricing: Controlling for Wider Economy

Dependent Variable ***Underpricing***	**OLS**				**2SLS**	
	E1	E2	F1	F2	G1	G2
UEO			-0.256**	-0.273**	-1.815**	-1.534**
			-2.02	-2.14	-2.05	-2.03
LNNGDP	-8.754	-8.856	-8.618	-8.827	-7.791	-8.695
	-0.62	-0.67	-0.62	-0.67	-0.36	-0.47
LNLAG	41.97**	32.13**	43.43**	34.17**	52.22***	43.59***
	2.50	2.40	2.61	2.59	2.92	2.76
LSIZE	-45.39**	-44.18**	-42.37**	-41.00**	-24.01	-26.33
	-2.32	-2.37	-2.29	-2.38	-1.14	-1.46
ROREA	0.301*	0.267	0.293	0.258	0.245	0.215
	1.72	1.38	1.63	1.28	1.25	1.27
LNAGE	-1.655	-2.086	-13.309	-14.504	-84.38	-71.86
	-0.06	-0.07	-0.46	-0.52	-1.46	-1.45
STATEO	67.76**	59.42*	76.79**	69.27**	131.8**	114.8**
	2.15	1.87	2.49	2.26	2.20	2.23
MR30	3.287*		3.050*		1.608	
	1.79		1.77		0.94	
DAY30	-0.785		-1.180		-3.590*	
	-0.90		-1.28		-1.65	
MR60		2.697***		2.575***		2.012**
		2.97		3.05		2.24
DAY60		-0.810*		-1.043*		-2.117**
		-1.67		-1.95		-2.11
Constant	256.8***	297.0***	286.6***	328.9***	468.6**	476.4***
	2.66	2.91	2.77	2.93	2.54	2.99
Adj R-squared	0.552	0.601	0.562	0.615		

This table presents the OLS regressions using state-ownership (*STATEO*), including 30-day and 60-day market variables respectively. *LNNGDP* is the regional net GDP calculated as the regional GDP excludes the (Exports – Imports) in the same area. The dependent variable is *Underpricing* which is the initial return between the first-trading day closing price and the IPO offering price, expressed as a percentage. *UEO* is the weighted average of the urban economic openness which is the sum of the city-level imports and exports as a share of this city's GDP. The land-use right that a company owns in one city as a share of its overall land-use right is used as the weight. *LNLAG* is the natural logarithm of the time lag between issuing and listing dates. *LSIZE* is the natural logarithm of the IPO proceeds. *ROREA* is the return on real estate assets of a company. *LNAGE* is the natural logarithm of the period of time for which the firm has been running as a real estate company before the IPO. *STATEO* is equal to 1 if the company is state-owned, 0 otherwise. *MR30* and *MR60* are 30- and 60-day market returns before the IPO. *DAY30* and *DAY60* are the IPO numbers in 30 and 60 days prior to IPO as a share of all the IPOs across the sample period respectively. t-statistics are in parentheses for OLS regressions and z-statistics are in parentheses for 2SLS regressions. ***, **, * denote significance at 1%, 5% or 10% respectively.

Comparing the baseline results (Table 11 and Table 13) with the ones in Table 16, we do not find significant differences. The coefficients of *UEO* remain negative and significant at a 95% confidence level, while the scale of the impact increases by 20% and 8% when controlling respectively for 30- and 60-day market conditions. The effect of the time lag between issuing and listing dates remains positive, while the significance is reduced. The firm size does not significantly affect IPO underpricing any longer and this is inconsistent with the information asymmetry theory, though supporting the main argument that there is the presence of a distortion in the application of classic theories to the Chinese market.

2SLS Model with Two Instruments

One limitation of using 2SLS estimation relates to the quality of instruments used in the first stage. By using disposable household income per capita, we have a just-identified case and therefore we cannot test for the exogeneity of the instrument, a key assumption of the 2SLS estimation. As an alternative measure to instrument *UEO*, we use the distance of each city to the nearest port, following Wang et al. (2011). As part of the policy started in 1979 to aim at a more globalized Chinese market, the government has agreed on fourteen coastal cities becoming major ports (e.g. Shanghai, Guangzhou, Dalian). Therefore, the distance to the nearest major port can be seen as a valid instrument for the city's trade openness. We follow the same procedure used for *UEO* to compute the weighted average of the distances for every company. Results of the over-identified 2SLS estimation using the disposable household income per capita and the distance of the city to its nearest major port are reported in Table 17.

Table 16 UEO and IPO Underpricing: Controlling for Time Effect

Dependent Variable ***Underpricing***	**OLS**		**2SLS**	
	H1	H2	I1	I2
UEO	-0.306**	-0.295**	-0.822***	-0.691**
	-2.02	-2.18	-2.76	-2.51
LNLAG	37.30**	25.61*	37.65***	27.05**
	2.03	1.80	2.98	2.32
LSIZE	-29.58	-33.09	-19.09	-24.96*
	-1.52	-1.63	-1.38	-1.95
ROREA	0.313*	0.299	0.300**	0.287**
	1.70	1.51	2.11	2.19
LNAGE	1.65	3.507	-15.2	-9.613
	0.05	0.12	-0.50	-0.34
STATEO	71.42**	69.42**	78.72**	74.31**
	2.18	2.20	1.97	2.06
MR30	2.947		2.346**	
	1.62		2.20	
DAY30	-0.301		-0.526	
	-0.26		-0.35	
MR60		2.495***		2.226***
		2.79		3.58
DAY60		-1.232		-1.299*
		-1.36		-1.71
TIME1	123.1*	69.65	174.1**	111.3*
	1.70	0.89	2.56	1.74
TIME2	38.84	-9.149	62.14	12.9
	0.77	-0.15	0.97	0.22
TIME3	-6.753	-48.76	29.29	-20.5
	-0.19	-1.09	0.57	-0.41
TIME5	26.62	-27.87	25.79	-26.1
	0.65	-0.62	0.43	-0.47
Constant	104.5	223.9	107	220.5*
	0.84	1.44	0.88	1.94
Adjusted R-squared	0.577	0.625		

This table presents OLS regressions including 30-day and 60-day market variables respectively. All the regressions in this table are controlled for time dummies. One time dummy was created to cover every five years. Five dummies are created while one was omitted in the regression due to collinearity. The dependent variable is *Underpricing* which is the initial return between the first-trading day closing price and the IPO offering price, expressed as a percentage. *UEO* is the weighted average of the urban economic openness which is the sum of the city-level imports and exports as a share of this city's GDP. The land-use right that a company owns in one city as a share of its overall land-use right is used as the weight. *LNLAG* is the natural logarithm of the time lag between issuing and listing dates. *LSIZE* is the natural logarithm of the IPO proceeds. *ROREA* is the return on real estate assets of a company. *LNAGE* is the natural logarithm of the period of time for which the firm has been running as a real estate company before the IPO. *STATEO* is equal to 1 if the company is state-owned, 0 otherwise. *MR30* and *MR60* are 30-day and 60-day market returns before the IPO. *DAY30* and *DAY60* are the IPO numbers in 30 days and 60 days prior IPO as a share of all the IPOs across the sample period respectively. t-statistics are in parentheses for OLS regressions and z-statistics are in parentheses for 2SLS regressions. ***, **, * denote significance at 1%, 5% or 10% respectively

Table 17 UEO and Underpricing (2SLS with Two Instruments)

Dependent Variable ***Underpricing***	**J1**	**J2**	**K1**	**K2**
UEO	-0.756**	-0.706**	-0.888**	-0.799***
	-0.35	-0.31	-0.35	-0.30
LNLAG	47.36***	52.10***	39.94***	44.50***
	11.66	10.85	11.55	10.63
LSIZE	-39.87***	-27.98**	-37.41***	-26.15**
	-11.74	-12.73	-11.45	-12.09
ROREA	0.284**	0.262**	0.243*	0.222*
	0.13	0.13	0.13	0.12
LNAGE	-37.04	-34.27	-43.4	-39.04
	-32.30	-30.14	-31.69	-29.04
STATEO	96.54***		93.89***	
	36.80		35.81	
CHINA		128.7***		126.9***
		37.75		36.15
DAY30	-2.006	-1.942*		
	-1.26	-1.17		
MR30	2.587**	2.515**		
	1.07	1.02		
DAY60			-1.585**	-1.402**
			-0.66	-0.61
MR60			2.299***	2.325***
			0.66	0.61
Constant	321.1***	194.9*	375.1***	240.5**
	103.8	104.6	102.2	101.9
Durbin (score) chi2(1)	2.9280	2.5001	5.0492	4.0607
	(p=0.0817)	(p=0.1138)	(p=0.0246)	(p=0.0439)
Wu-Hausman F(1,60)	2.61930	2.2224	4.6644	3.6949
	(p=0.1108)	(p=0.1413)	(p=0.0348)	(p=0.0593)

This table presents 2SLS estimations with two instruments, where group C regressions control for the 30-day market return and 30-day IPO numbers prior the IPO while group D regressions control for the 60-day variables. The dependent variable is *Underpricing* which is the initial return between the first-trading day closing price and the IPO offering price, expressed as a percentage. *UEO* is the weighted average of the urban economic openness which is the sum of the city-level imports and exports as a share of this city's GDP. The land-use right that a company owns in one city as a share of its overall land-use right is used as the weight. The instrumental variables for the *UEO* is the natural logarithm of the disposable household income per capita and the weighted average distance between the city where the properties are and the nearest ports. *LNLAG* is the natural logarithm of the time lag between issuing and listing dates. *LSIZE* is the natural logarithm of the IPO proceeds. *ROREA* is the return on real estate assets of a company. *LNAGE* is the natural logarithm of the period of time for which the firm has been running as a real estate company before the IPO. *STATEO* is equal to 1 if the company is state-owned, 0 otherwise. *CHINA* is equal to 1 of the company is listed in Mainland China, 0 otherwise. *MR30* and *MR60* are 30- and 60-day market returns before the IPO. *DAY30* and *DAY60* are the IPO numbers in 30 and 60 days prior IPO as a share of all the IPOs across the sample period respectively. z-statistics are in parentheses for 2SLS regressions. ***, **, * denote significance at 1%, 5% or 10% respectively.

Table 18 First-stage Regression of 2SLS and Exogeneity of Instruments

Panel A: First stage regression report				
	J1	J2	K1	K2
R-squared	0.3715	0.4128	0.3722	0.4039
F test	8.1672	10.0757	8.2073	9.7712
Prob > F	0.0007	0.0002	0.0007	0.0002
Panel B: Over - identification test (exogeneity of instruments)				
	J1	J2	K1	K2
p- value				
Sargan (score)	0.0437	0.1957	0.1539	0.5340
Basmann	0.0543	0.2253	0.1803	0.5637

The effect of UEO on IPO underpricing remains negative and significant, with coefficient decreasing while statistical significance is increasing. The negative results on *LSIZE* are now consistent with the classic theory that the larger the firm, the smaller the uncertainty and therefore the smaller the underpricing of the firm is. A more significant relationship is found between the return on real estate assets and underpricing. As we have argued earlier, investors see the return on real estate assets as a reflection of a real estate company's earning ability and they are more willing to pay more for companies with higher returns. Durbin and Wu-Hausman statistics are also reported here to test for the exogeneity of *UEO*. Excluding model J2 (insignificant Durbin and Wu-Hausman statistics), all other models report significant statistics, suggesting that *UEO* is indeed endogenous. Even though disposable household income per capita is a valid instrument, it may not be strong enough (see also Table 14). The joint significance of the two instruments is considerably increased according to the statistics of the first-stage regressions reported in Panel A of Table 18. The R- squared increases by at least 42% and the F-test increases by at least 54%.

As we have an over-identified case with two instrumental variables and one endogenous variable (*UEO*), we can run the over-identifying restriction tests to determine whether the instrumental variables are uncorrelated with the error term (i.e. exogeneity of the instruments). The Sargan (1958) and Basmann (1960) Chi-squared statistics are calculated by regressing the sample residuals on the error term and the null hypothesis is 'the instruments are exogenous'. We report the Sargan and Basmann statistics in Panel B of Table 18. If we exclude regression J1, all other models report insignificant statistics, suggesting that we cannot reject the null hypothesis. From the post-estimation tests on the quality of instruments, we conclude that, jointly, the two instruments are valid and effective for *UEO* and the negative effect of UEO on IPO underpricing is robust.

4.5 Summary

As the extreme IPO underpricing in emerging markets is not fully explained by existing empirical studies using theories valid in developed markets, we suggest a different approach to improve the explanation of this phenomenon. We find that the IPO initial return of companies with localised businesses is negatively affected by the urban economic openness (UEO) of the regions where the companies' businesses are operated. Higher UEO can lead to higher demand for real estate, or through the Balassa Samuelson effect, to higher wages in the non-tradable goods sector and hence to higher real estate prices. Moreover, an improvement in UEO can increase productivity, which is found to be a major determinant of a firm's profitability. All these channels decrease the uncertainty about the IPO valuation of a company. As a result, issuers have less incentive to underprice IPO shares. Chinese real estate companies provide a suitable experimental laboratory to establish this relationship. We find that these firms indeed show strong geographic investment patterns focused locally—usually at city level—and we also observe a highly heterogeneous degree of foreign trade across Chinese cities.

The findings demonstrate the influence of economic integration even within the country on IPO valuations. This study provides further evidence for the argument in the globalization literature that openness improves financial development. State-owned companies are also found to experience higher underpricing than privately owned companies, implying a negative impact of the special political system on the transparency in the financial market. Moreover, unlike previous studies, we show that a 60-day market return is a better proxy for market sentiment than the 30-day market return, which is attributed to the immaturity of the Chinese IPO market.

Comparing to the significant impacts of variables related to the special regime, such as state ownership, the results on variables proxy for the information asymmetry are quite mixed. Overall, information-asymmetry related variables show some influence on the IPO outcomes. However, the impact is not as strong and consistent as the market variables, indicating a weaker explanatory power of classic theories than that of behavioral arguments in China. This implies extra caution to be taken when applying the long-established classic theories in emerging markets, as they are exclusively developed under a mature market model with empirical evidence drawn from western datasets.

Finally, results are robust to the estimation of models with alternative specifications, including 2SLS models with disposable household income per capita and distance to ports as instruments.

To conclude, the results have implications for investors, owners and underwriters who may differentiate between IPOs of locally operating companies in more or less open regions. The findings also of interest to policy makers who focus on the impact of regional economic development on local companies.

Chapter 5 : IPO Valuation and the Role of Geographic and Asset Diversification: Evidence from U.S. REITs

In Chapter 4, we have identified a relationship between the urban economic openness and IPO short-run performance by using a real estate sample. The results imply the important role of the underlying real estate assets in the IPO valuation of a real estate company which needs to be further explored. In this chapter, we introduce another macroeconomic factor and investigate how the geographic locations of the underlying property assets can affect the real estate IPO valuation.

5.1 Introduction and Hypothesis Development

This study examines how the geographic (location) and property type diversification of a company's underlying assets affect its IPO valuation and short-run performance. Although the investment diversification of public companies has been extensively explored, studies on geographic and asset type diversification have been limited by a lack of data. The special characteristics and corporate governance rules of real estate companies offer an opportunity to construct several measures of diversification for both property type and asset location. Previous studies have partly explained the difference in the short-run performance of real estate and industrial IPOs, finding the former inadequately explained by the widely accepted theories based on information asymmetry. One argument is that real estate IPOs perform differently due to the high reporting standards and level of information made public by these companies. In other words, there is better transparency and less uncertainty about the valuation of real estate companies, leading to lower underpricing.

As mentioned in Chapter 2, real estate IPOs, along with the IPOs of other financial companies, are usually excluded from mainstream IPO studies. However, depending upon the sample size, time period, and market, the average initial return of real estate IPOs can be

negative. The relatively low underpricing, compared to industrial IPOs and the occasional overpricing of real estate IPOs, has become 'a puzzle within a puzzle'. Most classic theories have no or very limited explanatory power in the initial returns of real estate IPOs, especially as their assumption of information asymmetry implies a lowest initial return of 0% and cannot account for the overpricing.

Other attempts to explain the difference focus on the special characteristics of real estate IPOs, specifically the fund-like structure, the low involvement of institutional investors and the underlying real asset holdings. Section 2.6 in Chapter 2 provides a detailed review of the studies on real estate IPOs. In short, the former two characteristics particularly existed before the 1990s and cannot account for the real estate IPO performance after the 1990s. Previous studies suggest further investigations into the roles of the underlying real assets.

This study builds on these two strands of literature (effect of diversification on firm performance and real estate IPO performance) to propose a new approach to explain the IPO valuation of real estate companies, which does not require the assumption of information asymmetries, and sheds some light upon the variation in IPO initial returns within the U.S. REIT market.

While much of the limited literature on real estate IPOs is focused on why the initial returns are, on average, much lower than those of industrial IPOs, we cannot ignore that underpricing is also observed among real estate IPOs. For example, we find a 3.7% average initial return for the 175 IPOs in our sample with a standard deviation of 9.3%. However, the minimum initial return in our sample is -12.7%, whereas the maximum initial return is 45.8%, presenting a considerable variation.[30] The aim of this study is to investigate what determines the IPO valuation and drives this variation in REIT IPO initial returns, with a focus on the

[30] For more examples of initial returns of real estate IPOs, please refer to Chapter 2.

special characteristics of public real estate companies introduced by their underlying real asset holdings, rather than focusing on why REIT IPO underpricing is, on average, much lower than industrial IPOs.

The corporate diversification literature focuses on the impact of diversification on return performance and asset valuation across different industries and consistently finds support for the existence of a diversification discount.[31] Montgomery (1994) suggests that, in general, diversification does not positively affect firm performance and, in fact, may reduce expected returns by decreasing investment risk. In a real estate context, it is found that more diversified REITs have lower valuations than more concentrated REITs. The negative effect of diversification across property types is also documented by Campbell et al. (2003) and Cronqvist et al. (2001).

More recently, a growing literature examines how investment and corporate activities are influenced by the geographic location, including geographic diversification. Coval and Moskowitz (2001) document that investors prefer firms with headquarters in the city in which the managers live. Similar 'home bias' results are found in several studies arguing that investing in local firms provides investors with informational advantages.[32] For example, Landier et al. (2009) find that human capital and asset management decisions are affected by geographic dispersion, while Kang and Kim (2008) provide evidence that geographic proximity affects corporate acquisition decisions. However, these studies measure geographic proximity or dispersion based on the location of the company relative to its investors rather than on the locations of the firm's actual business activities or investments, due to the difficulty in data collection and construction.

[31] See, for example, Berger and Ofek (1995), Comment and Jarrell (1995), and Hund et al. (2010).
[32] See García and Norlib (2012) for a list of related studies.

Real estate companies with immobile underlying assets should be more prone to geographic influences. The transparency of real estate companies also makes it possible to construct geographic diversification based on exact asset holdings in different locations. The hypothesis of this study on the effects of asset locations on IPO initial returns is built on an investor base argument that is closely related to Merton (1987) and García and Norlib (2012). Merton (1987) argues that stocks with less investor recognition must offer higher expected returns to compensate investors for increased risk. García and Norlib (2012) study the geographic concentration of corporate business activities and show that 'local' firms have smaller investor bases and higher stock returns to compensate investors for concentrated risk. Ritter and Welch (2002) conclude that IPOs are one-off agency-based events in which initial returns are heavily dependent on the valuation of the IPO by underwriters and investors. Fundamental market valuation, asset pricing, and liquidity theories are unlikely to be able to explain short-run performance. Following Merton (1987), we argue that more focused firms have less investor recognition, which is normally detrimental to the success of an IPO as it decides the level of subscriptions. Therefore, issuers and underwriters need to underprice the shares to attract sufficient awareness of and participation from investors, resulting in higher initial returns. Although information-asymmetry-based theories are unable to explain the negative initial returns sometimes observed for REIT IPOs, the investor base argument does not assume the existence of information asymmetry and can also account for overpricing. Presented in this study is the first attempt to introduce a more exact method to calculate geographic diversification. The findings support the hypothesis that more diversified real estate companies (by property type or location) indeed experience lower IPO underpricing.

Based on the deadweight cost theory by Chan et al. (2009), we develop the second hypothesis. Substantial holdings of real estate properties give REITs more bargaining power in the IPO valuation. Chan et al. (2009) argue that when the IPO companies can sell the properties

quickly and cost effectively in the private market, the issuers will have less incentive to underprice shares. Should an IPO fail (i.e. be undersubscribed) they can always sell the properties in the private market instead. That is, the initial returns will decrease when the deadweight cost of the IPO is low. Conversely, when it is relatively difficult to dispose of the assets in the private market, issuers will underprice more to guarantee the IPO success.

The investor base argument is consistent with the deadweight cost theory. When the investor base or recognition of real estate companies increases with increasing geographic diversification, selling underlying assets in the private market becomes easier and cheaper. Therefore, according to the deadweight cost theory, issuers have less incentive to underprice, if not overprice, IPO shares, resulting in lower initial returns. More importantly, we discover a moderation effect that the deadweight cost factor holds in the relationship between the IPO valuation and the geographic diversification.

We argue that in a period when a company could liquidate their properties more efficiently, the impact of geographic diversification on the IPO valuation will be weakened. In other words, for a highly geographically concentrated company, the issuer will underprice the shares relatively less if they can sell the properties in the private market quickly and cost-effectively, should the IPO fail. As higher returns and transaction volumes in the private market are indicators of a friendlier condition for selling properties, we find evidence supporting the second hypothesis that the scale of the impact of the geographic concentration on IPO initial returns is reduced when the return and liquidity (transaction turnover) is higher in the private market.

Despite the varying effects diversification may have on a company's performance and the mechanisms through which these effects are transmitted, the measurement of diversification, and especially geographic diversification of particular businesses, at company level is not straightforward. Real estate markets are decidedly local in nature, which may provide an

information advantage to firms and individuals who have invested in obtaining local market knowledge. In addition, most real estate companies focus their portfolios on one or a few property types with a clear definition of their concentration strategy prior to their IPO. This, coupled with the fact that there is greater homogeneity in the structure and firm characteristics among REITs than within other industries, makes REITs a suitable laboratory to disentangle the effect on IPO initial returns of diversification from other cross-firm characteristics—as Hartzell et al. (2014) also argue.

The remainder of this chapter is organised as follows: Section 5.2 presents the data collection, variable construction, and methodology. Section 5.3 discusses the main results and relevant robustness checks, while the last section concludes this study. As a detailed review on the real estate and general IPO literature can be found in Chapter 2 as well as Chapter 4, we do not repeat them in this chapter.

5.2 Data and Methodology

The sample includes 171 US real estate IPOs from 1995 to 2014 and is collected from the Security Data Company (SDC) New Issues Database. We only include IPOs with information on both the offer price and first-trading-day closing price as both are required to calculate initial returns. Firm and issuing-level characteristics (e.g. venture-capital status, pricing technique, and offer size) are also obtained from the SDC database. Control variables for general market conditions at the time of the IPO (e.g. pre-IPO market return and turnover) are collected from Thomson Reuters DataStream. The total return on the NCREIF Property Index (NPI) is included to control for conditions in the private real estate market.[33] The NECREIF quarterly transaction data is used to calculate the volume-based turnover in order to

[33] Established in 1982, NCREIF is a not-for-profit institutional real estate industry association that collects, processes, validates, and disseminates information on the risk/return characteristics of commercial real estate assets owned by institutional (primarily pension and endowment fund) investors. The property composition of the NPI changes quarterly as data contributing NCREIF members buy and sell properties. However, all historical property-level data remain in the database and index.

capture the liquidity in the private market. Our property type and geographic diversification variables are manually extracted from the IPO prospectus, the 10-K fillings for the IPO year, or the SNL Property database.

The IPO initial return (*IR*) is computed as the difference between the closing price on the first trading day (hereafter the close price) and the IPO offer price, as a percentage of the offer price. To recall, we follow the majority of the empirical studies and do not adjust the IPO initial return by market return in the previous two chapters as the average market return is rather minor compared to the high level of underpricing of industrial IPOs. However, we cannot assume so when it comes to real estate IPOs which experience lower initial returns. Therefore, we adjust the initial return by subtracting the market return on the first day of trading as follows:

$$Initial\ Return = \frac{(Close\ Price - Offer\ Price)}{Offer\ Price} - Market\ Return \quad (\%) \qquad \text{Equation 18}$$

We construct two Herfindahl Indexes to measure both geographic and property type (or sector/asset-type) diversification. For each IPO company, we first calculate the share of properties in each state by manually extracting information on the size (square feet) of real estate holdings in that state at the time of the IPO. For certain property types (e.g. hotels, healthcare centres and multifamily communities) where property size is not reported in square feet, other size measurements (e.g. number of rooms and units) are used. Similarly, we collect information on the value of each property and calculate the percentage of assets for each property type. For hotel assets (with property values not reported), we use the product of the average daily rate, number of rooms, and the average occupancy rate.[34] The Herfindahl Index

[34] As the property type-level value is not reported for Select Income REIT, we equally divide the value by the number of asset type. For Boston Properties Inc. and Prime Group Realty Trust where the value of properties is not reported, we use the size of properties instead. We also estimate the models excluding these IPOs and results do not change significantly.

for geographic and property type diversification is calculated as the sum of the squared proportions, as follows:

$$Herfindahl\ Index\ (HHI) = \sum_{i}^{n} P_i^2 \qquad \text{Equation 19}$$

where P_i represents the proportion of properties the company owns in a state or in an asset type and *n* is the total number of states or property types in which the company invests. The Herfindahl Index can range from 0 to 10000 with higher values representing higher levels of concentration. For estimation purpose, we scale both indexes by 10000, leaving a range between 0 and 1.

We next construct a Herfindahl Index at the economic region level for each IPO company, by grouping its properties into eight economic regions as defined by Hartzell et al. (1987). [35] This index allows us to test whether the primary measure of geographical diversification is appropriate and to determine if the underlying economy is driving the initial returns, rather than the investor base/recognition argument.

As a robustness check, we test four alternative geographic measures. Specifically, we include the number of states where the IPO company invests properties. We also create a dummy variable which is set equal to 1 if the headquarter state of the company is also the home to the largest concentration of properties. Finally, as a measure of geographic proximity, we calculate the average distance between each state where the company owns properties and its

[35] Hartzell et al. (1987) divide all the states into eight regions, according to their alike underlying economies, which are New England, Mid-Atlantic Corridor, Old South, Industrial Midwest, Farm Belt, Mineral Extraction Area, South California and North California. For more details, please refer to their paper.

headquarter state. We construct both simple average and weighted-average variables where the share of total size of properties in each state is used as the weight, presented in the following:

$$Average\ Geographic\ Proximity_j = \frac{1}{n}\sum_{i}^{n} d_{ij} \quad \text{Equation 20}$$

$$Weighted\ Geographic\ Proximity_j = \sum_{i}^{n} p_{ij} d_{ij} \quad \text{Equation 21}$$

where d_{ij} is the distance (in miles) between state i where company j owns properties and the headquarter state of company j, n is the total number of states where company j owns properties, and p_{ij} is the percentage of the portfolio that company j owns in state i.

Similarly, we include two alternative measures of property type diversification. We construct a dummy variable which is set equal to 1 if the firm invests in just one property type and 0 otherwise (e.g. a focused REIT has a value of 1). We also create a variable that is equal to the number of property types in which a REIT invests.

We use the one-quarter lagged NCREIF PPI return (*LNCREIF*) and private market liquidity (*LIQUIDITY*) as indicators of the deadweight cost. *LIQUIDITY* is measured by the percentage of properties in the NCREIF Index that were sold in the IPO quarter. To test the second hypothesis, we interact the geographic diversification variable with each indicator of the deadweight cost.

We also include firm- and market-level control variables which are similar to those in previous two Chapters. Specifically, we include firm size (*LSIZE*) and two dummy variables indicating the use of book-building pricing technique (*BB*) and venture-capital-backed status (*VB*). We also include *MRETURN* and *VOLUME* which measure the market return and IPO

number prior to the IPO respectively. As discussed in Section 2.4 that the pre-IPO market return measures the sentiment which drives up the first-day closing price, we expect a positive relationship between the *MRETURN* and real estate IPO initial returns. As an alternative to the lagged NCREIF NPI return, we weight *LNCREIF* by the percentage of properties each REIT owns in each of the four geographic regions defined by NCREIF: East, West, South and Midwest. Finally, we control for IPO investment opportunities available in each state by constructing a state-level IPO density variable. *DENSITY* is equal to the number of firms issuing IPOs that are headquartered in one state in a sample year, divided by the state population in that year, weighted by the size of the portfolio that the issuing firm has in each of the states. Table 19 reports the definitions of all variables included in this study and associated data sources.

Table 20 presents summary statistics for the regression variables. The average market-adjusted initial return for the full sample (171 IPOs) is 3.70%. This is greater than the average initial return of 2.79% recorded by Chan et al. (2013) from 1996 to 2010 and less than the 5.34% average initial return documented by Gokkaya et al. (2015) from 1993 to 2007. After excluding 28 real estate operating companies (REOCs) in the sample, the average initial return is 2.34%. The relatively low initial return supports the notion that industrial and real estate (especially REIT) IPOs might be materially different. For example, according to Ritter (2017), the average initial return of US industrial IPOs is constantly above zero across the sample period, with a minimum of 5.7% in 2008 and a maximum of 71.1% in 1999. The minimum initial return in our sample is -12.7%, while the maximum initial return is 45.8%. The standard deviation is 9.3%.

As expected, few real estate IPOs are venture-capital backed and the majority of real estate IPOs use book-building to price their shares. Average total IPO proceeds (*LSIZE* represents the log-transformed total proceeds) is $265.85 million, a value similar to the mean industrial IPO size as reported in Ritter (2017) for the period 1999-2015, suggesting that real

estate IPOs are not necessarily small-firm IPOs. Consistent with the focused geographic strategy of most listed real estate companies and the localised nature, the average number of states in which REITs own properties is nine. Furthermore, 17 of 125 companies, for which we have full geographic information, concentrate all their investments in one state. In contrast, only six IPO companies invest in more than half of the U.S. states. In addition, 57 companies hold the largest percentage of their portfolio in the state where they are headquartered, indicating a substantial home bias. Finally, 83 of 104 REITs, for which we have data, invest in only one property type.

Few statistically significant correlations are uncovered among our independent variables (all below 0.3, with many approximately zero). Table 21 contains the correlations between different measures of diversification/concentration. Correlations are positive if both proxies represent diversification (e.g. *DIST* and *DIST_W*) or concentration (*HHI_GEO* and *HHI_GEO_ECO*; *FOCUSED* and *HHI_ASSET*). Negative coefficients are found when a diversification proxy is correlated with a concentration proxy (e.g. *DIST* and *HHI_GEO*; *LASSET* and *HHI_ASSET*). The correlations between all proxies for geography have an absolute coefficient above 0.56, while proxies for asset type diversification display even stronger correlations (the minimum is 0.87). Interestingly, no significant relation is found between geographic and asset type diversification/concentration measures. The only marginally significant coefficient is found between *HHI_GEO* and the first two proxies of asset type diversification (*FOCUSED* and *LASSET*). Hence, initially, we do not use them jointly in the estimations.

Table 19 Variables Description: Firm-, Issuing- and Geographic Factors (Chapter 5)

Variable	Description
IR	Market-adjusted IPO initial return which is the difference between the IPO offer price and the first-trading-day closing price, excluding the market return on the IPO day. Source: SDC Database and CRSP
VB	A dummy variable which equals 1 if the IPO is venture-capital-backed; 0 otherwise. Source: SDC Database
BB	A dummy variable which equals 1 if the IPO uses bookbuilding as pricing technique. Source: SDC Database
LSIZE	Log-transformed total proceeds of the IPO. Source: SDC Database
MRETURN	Three-month cumulative market return before the IPO date. Source: DataStream
VOLUME	The number of IPOs in a certain year divided by the total number of IPO across the sample period, presented as a percentage. Source: SDC Database
LNCREIF	One-quarter lagged NCREIF Property Index Return. Source: NCREIF Website
LNCREIF_W	One-quarter lagged NCREIF Property Index Return, weighted by the size of the property assets that the IPO company has in each of the four geographical regions by NCREIF definition, which are East, West, South and Midwest. Source: NCREIF Website
LIQUIDITY	Transaction turnover which is the percentage of the number of properties sold from the NCREIF NPI Index as a measure of private market liquidity. Source: NCREIF
DENSITY	The state-level IPO density which is, for one year, the number of IPOs that headquartered in the state divided by the population in this state. For each IPO, it is weighted by the size of the property assets that the IPO company has in each of the states. Source: SDC Database and The United States Census Bureau
LSTATES	Number of states where the IPO company's property assets are located, log-transformed. Source: IPO Prospectus and 10-K File
HEAD	A dummy variable which equals 1 if the company has most of its properties in its headquarter state, 0 otherwise. Source: IPO Prospectus and 10-K File.
DIST	Average geographic proximity which measures the distance between the state where the IPO company's property assets are located and the state where the company's headquarter is located. Source: IPO Prospectus and 10-K File

Table 19 Variables Description: Firm-, Issuing- and Geographic Factors (Continued)

Variable	Description
DIST_W	Geographic proximity which measures the distance between the state where the IPO company's property assets are located and the state where the company's headquarter is located, weighted by the size of the property assets that the IPO company has in the state. Source: IPO Prospectus and 10-K File
HHI_GEO	Geographic Herfindahl index which is calculated as the sum of the squared shares of property size that the IPO company has in each state; after scaling it by 10000, it ranges from 0 to 1 with lower value representing higher geographic diversification. Source: IPO Prospectus and 10-K File
HHI_GEO_ECO	Geographic Herfindahl index which is calculated as the sum of the squared shares of property size that the IPO company has in each of the eight economic regions which are defined by Hartzell et al (1987); after scaling it by 10000, it ranges from 0 to 1 with lower value representing higher geographic diversification. Source: IPO Prospectus and 10-K File
FOCUSED	A dummy variable which equals 1 if it is focused-REIT, 0 otherwise; Source: CRSP and SNL
LASSET	Number of asset types that the IPO company has, log-transformed. Source: IPO Prospectus and 10-K File
HHI_ASSET	Asset-type-based Herfindahl index which is calculated as the sum of the squared shares of property value that the IPO company has in each property type; after scaling it by 10000, it ranges from 0 to 1 with lower value representing higher property type diversification. Source: IPO Prospectus and 10-K File

Table 20 Summary Statistics of Variables

Variables	**Mean**	**Median**	**Min**	**Max**	**StD**	**N**
IR	3.697	0.750	-12.72	45.84	9.290	171
VB	0.041	0.000	0.000	1.000	0.199	171
BB	0.988	1.000	0.000	1.000	0.108	171
LSIZE	5.167	5.249	1.609	7.877	0.968	171
MRETURN	5.420	4.929	-15.84	34.35	6.664	171
VOLUME	5.425	5.340	1.644	10.50	1.953	171
LNCREIF	2.806	2.820	-7.330	5.430	1.797	171
LNCREIF_W	2.811	2.967	-7.419	5.620	1.549	125
LIQUIDITY	*3.402*	3.321	0.686	6.383	1.443	171
DENSITY	0.000	0.000	0.000	0.002	0.000	129
LSTATES	1.731	1.792	0.000	3.761	0.988	125
HEAD	0.456	0.000	0.000	1.000	0.501	125
DIST	965.3	1029	0.000	2321	594.9	125
DIST_W	890.2	971.6	0.000	3161	624.0	125
HHI_GEO	0.385	0.273	0.048	1.000	0.305	125
HHI_GEO_ECO	0.457	0.345	0.046	1.000	0.298	125
FOCUSED	0.798	1.000	0.000	1.000	0.403	104
LASSET	0.192	0.000	0.000	1.609	0.407	104
HHI_ASSET	0.926	1.000	0.329	1.000	0.171	104

Table 21 Correlation Matrix
Panel A: Correlation between diversification variables and control variables

	VB	*BB*	*LSIZE*	*MRETURN*	*VOLUME*	*LNCREIF*	*LNCREIF_W*	*LIQUIDITY*
VB	1							
BB	0.0225	1						
LSIZE	-0.0155	0.2063*	1					
MRETURN	-0.0552	0.0649	0.0393	1				
VOLUME	-0.0327	0.0288	-0.2108*	0.1369*	1			
LNCREIF	0.0674	0.0217	0.0132	-0.2822*	0.2303*	1		
LNCREIF_W	0.0820	0.0306	0.0662	-0.2286*	0.1621*	0.9759*	1	
LIQUIDITY	0.0401	0.0063	0.0712	-0.0846	0.2713*	0.3866*	0.3560*	1
DENSITY	-0.0423	0.1299	0.1161	0.0604	0.1914*	0.0985	0.1064	0.0613
LSTATES	0.1226	0.0652	0.1952*	0.0423	-0.0908	-0.0483	-0.0744	-0.1152
DIST	0.0837	-0.0322	0.1838*	-0.0054	-0.0831	-0.0759	-0.0739	-0.0541
DIST_W	0.0355	-0.0787	0.1268	-0.0235	-0.1476*	-0.1236	-0.1349	-0.0884
HHI_GEO	-0.1184	-0.0311	-0.1242	-0.0478	0.0622	0.0336	0.0746	0.0462
HHI_GEO_ECO	-0.1105	-0.0275	-0.1869*	-0.0827	0.1107	0.1077	0.1352	0.1136
FOCUSED	-0.2006*	-0.0689	-0.1199	0.0095	-0.093	-0.0766	-0.0771	-0.0219
LASSET	0.2314*	0.0649	0.1119	0.0073	0.0750	0.1020	0.1003	0.0615
HHI_ASSET	-0.2527*	-0.0601	-0.1239	-0.0198	-0.0750	-0.0624	-0.0580	-0.0131

Table 21 Correlation Matrix
Panel B: Correlation between diversification variables

	DENSITY	*LSTATES*	*DIST*	*DIST_W*	*HHI_GEO*	*HHI_GEO_ ECO*	*FOCUSED*	*LASSET*	*HHI_ASSET*
DENSITY	1								
LSTATES	-0.0012	1							
DIST	0.0833	0.6136*	1						
DIST_W	0.0431	0.5629*	0.7898*	1					
HHI_GEO	0.0705	-0.9028*	-0.6155*	-0.6471*	1				
HHI_GEO_ECO	-0.0262	-0.7835*	-0.7651*	-0.7642*	0.8249*	1			
FOCUSED	-0.1219	0.1492	0.0087	0.1235	-0.2597*	-0.1137	1		
LASSET	0.1404	-0.1276	0.0355	-0.1134	0.2152*	0.0800	-0.9415*	1	
HHI_ASSET	-0.1325	0.0452	-0.0532	0.0320	-0.1294	0.0002	0.8721*	-0.9044*	1

Following the IPO literature, we conduct a multivariate analysis to test the effects of both geographic and property type diversification by estimating the following equations using OLS:

$$IR = C + \beta_1 HHI\_GEO + \sum_{i=1}^{m} \beta_i V_i + \epsilon \quad \text{Equation 22}$$

$$IR = C + \beta_1 HHI\_ASSET + \sum_{i=1}^{m} \beta_i V_i + \epsilon \quad \text{Equation 23}$$

The dependent variable in both equations is the firm's initial return (*IR*), β_1 captures the effects of geographic and property type diversification, respectively, and V_i represents a vector of *m* control variables.

5.3 Results and Robustness Tests

5.3.1 Geographic and Property Type Diversification

Table 22 reports the main results of the initial return model using several measures of firm-level geographic diversification/concentration. Robust standard errors are reported below the coefficients. Ideally, we would include annual fixed effects to control for time variation in local, state, and national economic conditions, not captured by other control variables including conditions in commercial real estate markets. However, with 125 total IPO observations, we use three-year windows for the time fixed effects to preserve more degrees of freedom. The sensitivity of the results to this assumption is examined below. Results reported in column (1) of Table 22 contain the primary variable of interest, *HHI_GEO*.

If we recall, we present a positive impact of the venture-backed status on IPO underpricing based on industrial IPOs in Chapter 3, contradicting the conventional certification

argument by Megginson and Weiss (1991) . However, a negative and significant coefficient of *VB* is found in this study. Real estate IPOs backed by venture capital firms are found to be associated with significantly lower initial returns which presents a certification role of the venture capitalists in real estate IPO valuation.

The size of the offering (*LSIZE*) is not predictive of initial returns. This is in sharp contrast to most empirical studies of industrial IPOs. However, it is consistent with the argument that classic information-asymmetry-based theories have little ability to explain the cross-section variation of initial returns of REIT IPOs (Brounen and Eichholtz, 2002, Wong et al., 2013b). In fact, as we can see now it is not the first time that the firm size, arguably the most commonly used measure of information asymmetry or uncertainty, fails to or only weakly explains the initial returns of IPOs in certain markets or sectors in this thesis.

The estimated coefficient of the broad-based stock market return in the three months prior to the IPO (*MRETURN*) is positive and highly significant, indicating higher initial returns in rising markets. Once again, this finding supports the behavioural arguments (Loughran and Ritter, 2002, Ljungqvist et al., 2006) which posit that IPO short-run performance is also driven by investor sentiment. The estimated coefficient on *VOLUME* cannot be distinguished from zero, which suggests that the IPO volume prior to the IPO does not affect pricing in this industry.

The inclusion of *MRETURN* controls for the recent performance of the general stock market. However, given the unique features of real estate industry, we posit that the performance of an IPO is also driven by the recent return performance of the underlying private real estate asset market. The estimated coefficient on *LNCREIF* is positive and highly significant. Thus, a hot private real estate market is also predictive of higher first-day IPO returns, even after controlling for recent returns in the general stock market.

Table 22 Geographic Diversification and IPO Initial Returns

Dependent Variable ***Underpricing***	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
VB	-4.368*	-4.876**	-5.080**	-5.116**	-4.767*
	-2.317	-2.355	-1.945	-2.402	-2.568
BB	-7.811	-8.777	-7.646	-8.717	-8.490
	-8.336	-8.738	-7.184	-6.546	-7.249
LSIZE	1.321	1.396	1.078	1.28	1.295
	1.293	1.332	1.327	1.296	1.332
MRETURN	0.432***	0.440***	0.411**	0.412**	0.414**
	0.155	0.155	0.163	0.162	0.158
VOLUME	-1.233	-0.205	-1.299	-1.233	-1.266
	-1.065	-1.573	-1.101	-1.07	-1.073
LNCREIF	1.164**	0.989*	1.252**	1.058**	1.112**
	0.491	0.553	0.528	0.529	0.529
LIQUIDITY	-0.248	-0.657	-0.173	-0.239	-0.262
	-0.569	-0.683	-0.572	-0.573	-0.574
DENSITY	-6,156**	-5,346*	-5,710**	-5,272*	-5,319*
	-2,663	-2,765	-2,738	-2,802	-2,743
HHI_GEO	4.739**				
	2.028				
LSTATES		-0.838			
		-0.737			
HEAD			1.775		
			1.486		
DIST_W				-0.002*	
				-0.001	
DIST					-0.001
					-0.001
Time Dummies	Y	Y	Y	Y	Y
Constant	12.80	10.29	14.53	17.14	17.03
	13.18	15.25	12.47	12.58	12.9
Observations	125	125	125	125	125
Adj R-squared	0.257	0.212	0.239	0.245	0.238

This table presents Ordinary Least Squares estimations for a cross-section of real estate IPOs that have taken place between 1995 and 2014 in the U.S.. The dependent variable is *Underpricing* which is the initial return between the first-trading day closing price and the IPO offer price, adjusted for market returns and expressed as a percentage. The variable of interest is *HHI_GEO* in column (1), representing the geographic diversification which is calculated as the sum of the squared shares of property size that the IPO company has in each state, scaled by 10000, ranging from 0 to 1 with lower value representing higher geographic diversification. *HHI_GEO* is replaced by *LSTATES* in column (2), which is the natural log of the number of states where the company invests properties. *Head* in column (3) is a dummy variable which equals 1 if the company has most of its properties in the headquarter state; 0 otherwise. *DIST_W* in column (4) is the geographic proximity which measures the distance between the state where the IPO company's property assets are located and the state where the company's headquarter is located, weighted by the size of the property assets that the IPO company has in the state. *DIST* in column (5) is simply the average geographic proximity. *VB* is a dummy variable which equals 1 if the IPO is venture-capital-backed; 0 otherwise. *BB* is a dummy variable which equals 1 if the IPO uses bookbuilding as the pricing technique; 0 otherwise. *LSIZE* is the log-transformed total proceeds of the IPO. *MRETURN* is the three-month cumulative market return before the IPO date, based on the DataStream Market Index. *VOLUME* is measured as the number of IPOs in a certain year divided by the total number of IPOs across the sample period, presented as a percentage. *LNCREIF* is the one-quarter lagged NCREIF Property Index Return. *LIQUIDITY* is

the primary market liquidity measured by the number of properties sold in the IPO year as a percentage of the total outstanding properties that year. *DENSITY* measures the state-level IPO density which is, for one year, the number of IPOs that headquartered in the state divided by the population in this state, weighted by the size of the property assets that the IPO company has in each of the states. Time dummies are included for all the estimations. One time dummy is created for every 3-year window. t-statistics are corrected for robustness and presented below the coefficient estimates. ***, **, * denote significance at 1%, 5% or 10% respectively.

The first explanatory variable related to geography, *DENSITY*, proxies for the exposure investors have to the broader IPO market in the state where the IPO firm is headquartered. The estimated coefficient on *DENSITY* is negative and significant at the 5% level, suggesting that a higher concentration of IPOs in the state in which the firm is headquartered reduce initial returns because the process of information sharing becomes more efficient. This supports the information-spillover argument by Altı (2005) who argues that there is an unknown common factor in the IPO valuation which will be gradually revealed by previous IPOs.

We now turn to our primary variable of interest. The coefficient estimate of *HHI_GEO* is positive and significant. As the Herfindahl Index is scaled by 10000, the result shows that 1000 points increase in the index results in 0.47% decrease in the underpricing, which is a significant amount considering that the average initial return of REITs IPOs is around 2.3%. This provides support for the investor base argument that less geographic diversification is associated with higher IPO initial returns because issuers need to underprice more to make up for the insufficient recognition of their companies and to compensate investors for the greater risk of geographically concentrated portfolios (García and Norlib, 2012).

In column (2) of

Table 22 we replace *HHI_GEO* with *LSTATES*, which measures the number of states in which the IPO company's properties are located. In column (3) we replace *HHI_GEO* with *HEAD*, which is a dummy set equal to 1 if the firm has most of its properties in its headquarter state. In column (4) we use *DIST_W* as our measure of geographic concentration. Finally,

column (5) reports the coefficient estimate on *DIST*, which is computed similarly to *DIST_W* but uses a simple average value of distances without weighting by property size in each state. In all four models using the alternative proxies for geographic concentration we find no statistical significance. Hence, we conclude that the Herfindahl Index is the only adequate proxy for geographic concentration. This supports the importance of geographic diversification in explaining IPO underpricing. A higher concentration generates higher underpricing with companies wanting to attract a broader investor base. More importantly, it is not limited to the assumption of information asymmetry, which cannot account for the overpricing. When a real estate company is highly geographically diversified with a wide-spread investment base or the real estate company is well-recognised, the issuer has no incentive to underprice, if not taking the chance to overprice, the IPO shares.

We next examine how property type diversification affects IPO initial returns, with proxies for geographic diversification excluded from the analysis. These results are reported in Table 23. The estimated coefficient of *MRETURN* remains positive and highly significant in all three specifications; the estimated coefficients of *VOLUME* cannot be distinguished from zero. The estimated coefficients of *LNCREIF* remain positive, although with reduced statistical significance. In Table 23, the estimated coefficients of *DENSITY* are still negative and significant in all specifications but with slightly reduced statistical significance relative to the results reported in Table 22.

Table 23 Property Type Diversification and IPO Initial Returns

Dependent Variable ***Underpricing***	**(1)**	**(2)**	**(3)**
VB	-4.817*	-4.981*	-4.691
	-2.823	-2.823	-2.845
BB	-9.061	-9.095	-9.041
	-8.579	-8.518	-8.523
LSIZE	1.433	1.473	1.444
	1.502	1.500	1.502
MRETURN	0.436**	0.420**	0.427**
	0.169	0.164	0.165
VOLUME	-0.231	-0.223	-0.255
	-1.601	-1.604	-1.601
LNCREIF	1.145*	1.150*	1.162*
	0.669	0.686	0.677
LIQUIDITY	-0.841	-0.863	-0.816
	-0.872	-0.877	-0.876
DENSITY	-5,505*	-5,842*	-5,600*
	-3,105	-3,093	-3,115
HHI_ASSET	5.515*		
	3.222		
FOCUSED		2.460*	
		1.470	
LASSET			-2.660**
			-1.297
Time Dummies	Y	Y	Y
Constant	0.933	3.964	6.357
	11.13	10.71	10.65
Observations	105	105	105
Adj R-squared	0.233	0.235	0.237

This table presents the Ordinary Least squares estimations for a cross-section of real estate IPOs that have taken place between 1995 and 2014 in the U.S. The dependent variable is *Underpricing* which is the initial return between the first-trading day closing price and the IPO offer price, adjusted for market returns and expressed as a percentage. The variable of interest is *HHI_ASSET* in column (1), representing the property type diversification which is calculated as the sum of the squared shares of property value that the IPO company has in each property type, scaled by 10000, ranging from 0 to 1 with lower value representing higher property type diversification. *HHI_ASSET* is replaced by *FOCUSED* in column (2), which is a dummy variable which equals 1 if it is a focused REIT; 0 otherwise. *LASSET* in column (3) is the natural log of the number of asset types that the IPO company has. *VB* is a dummy variable which equals 1 if the IPO is venture-capital-backed; 0 otherwise. *BB* is a dummy variable which equals 1 if the IPO uses bookbuilding as a pricing technique; 0 otherwise. *LSIZE* is the log-transformed total proceeds of the IPO. *MRETURN* is the three-month cumulative market return before the IPO date, based on the DataStream Market Index. *VOLUME* is measured as the number of IPOs in a certain year divided by the total number of IPO across the sample period, presented as a percentage. *LNCREIF* is the one-quarter lagged NCREIF Property Index Return. *LIQUIDITY* is the primary market liquidity measured by the number of properties sold in the IPO year as a percentage of the total outstanding properties that year. *DENSITY* measures the state-level IPO density which is, for one year, the number of IPOs that headquartered in the state divided by the population in this state, weighted by the size of the property assets that the IPO company has in each of the states. Time dummies are included for all the estimations. One time dummy is created for every 3-year window. T-statistics are corrected for robustness and presented below the coefficient estimates. ***, **, * denote significance at 1%, 5% or 10% respectively.

Table 24 Geographic and Property Type Diversification, Fixed Time Effect

Dependent Variable ***Underpricing***	**(1)**	**(2)**	**(3)**	**(4)**
VB	-3.253	-3.083	-2.711	-2.637
	-2.86	-2.819	-3.104	-3.135
BB	-7.302	-7.385	-7.085	-7.233
	-8.407	-8.529	-9.002	-9.095
LSIZE	1.396	1.402	1.225	1.228
	1.415	1.409	1.436	1.44
MRETURN	0.456***	0.448***	0.638**	0.632**
	0.168	0.167	0.248	0.251
VOLUME	-1.479	-1.442	-3.976***	-3.989***
	-1.181	-1.153	-0.631	-0.631
LNCREIF	1.227**		-0.261	
	0.598		-1.428	
LNCREIF_W		1.213**		0.309
		0.54		1.068
LIQUIDITY	-0.209	-0.257	-0.135	-0.178
	-0.734	-0.732	-0.837	-0.851
DENSITY	-5,475*	-5,694**	-7,315**	-7,179**
	-2,776	-2,762	-2,952	-2,863
HHI_ASSET	7.189**	7.116**	6.290*	6.453*
	3.323	3.315	3.493	3.436
HHI_GEO	5.083**	4.911**	5.655**	5.619**
	2.275	2.243	2.556	2.551
Time Dummies	Y	Y	N	N
Fixed Time Effects	N	N	Y	Y
Constant	-3.305	-3.022	-22.90	-18.49
	-10.79	-10.89	-17.59	-15.69
Observations	104	104	104	104
Adj R-squared	0.286	0.289	0.345	0.345

This table presents Ordinary Least Squares estimation for a cross-section of real estate IPOs that have taken place between 1995 and 2014 in the U.S. The dependent variable is *Underpricing* which is the initial return between the first-trading day closing price and the IPO offer price, adjusted for market returns and expressed as a percentage. The variables of interests are *HHI_GEO* and *HHI_ASSET*. *HHI_GEO* represents the geographic diversification which is calculated as the sum of the squared shares of property size that the IPO company has in each state, scaled by 10000, ranging from 0 to 1 with lower value representing higher geographic diversification. *HHI_ASSET* represents the property type diversification which is calculated as the sum of the squared shares of property value that the IPO company has in each property type, scaled by 10000, ranging from 0 to 1 with lower value representing higher property type diversification. *VB* is a dummy variable which equals 1 if the IPO is venture-capital-backed; 0 otherwise. *BB* is a dummy variable which equals 1 if the IPO uses bookbuilding as a pricing technique; 0 otherwise. *LSIZE* is the log-transformed total proceeds of the IPO. *MRETURN* is the three-month cumulative market return before the IPO date, based on the DataStream Market Index. *VOLUME* is measured as the number of IPOs in a certain year divided by the total number of IPO across the sample period, presented as a percentage. *LNCREIF* is the one-quarter lagged NCREIF Property Index Return. *LNCREFI_W* is the one-quarter lagged NCREIF Property Index Return, weighted by the size of the property assets that the IPO company has in each of the four geographic regions by NCREIF definition, which are East, West, South and Midwest. *LIQUIDITY* is the primary market liquidity measured by the number of properties sold in the IPO year as a percentage of the total outstanding properties that year. *DENSITY* measures the state-level IPO density which is, for one year, the number of IPOs that headquartered in the state divided by the population in this state, weighted by the size of the property assets that the IPO company has in each of the states. The year fixed effect is adopted in column (3) and (4). Time dummies are included for estimations in column (1) and (2). One time dummy is created for every 3-year window. Time fixed

effects are controlled in columns (3) and (4). t-statistics are corrected for robustness and presented below the coefficient estimates. ***, **, * denote significance at 1%, 5% or 10% respectively.

The regression results reported in column (1) of Table 23 include *HHI_ASSET* as a proxy for the asset-type concentration. The coefficient estimate is positive and significant at 10%, providing some support for the notion that more property type specialization is associated with higher initial returns. This suggests investors need to be compensated for the increased risk associated with a more concentrated portfolio. In column (2) we replace *HHI_ASSET* with *FOCUSED* and find a positive and marginally significant coefficient, which is consistent with the previous finding. The positive effect of property type diversification is consistent with Brounen and Eichholtz (2002) who find a significantly higher initial return for IPO companies holding more than 80% in one asset type.

In column (3) we replace *HHI_ASSET* with *LASSET*, which represents the logarithm of the number of property types the IPO firm owns. The estimated coefficient on *LASSET*, a measure of diversification and not concentration, is negative and significant, providing supporting evidence that fewer property types (more focus) are associated with higher initial returns. However, we use Herfindahl Indexes to measure both geographic and asset type diversification in the remainder of the analysis for three reasons. Firstly, the Herfindahl index represents a more precise measure of the degree of portfolio diversification of the company. Secondly, we find a much stronger ability of HHI to proxy for geographic concentration compared to other proxies, still having HHI for asset type being significant. Thirdly, *HHI_GEO* is correlated (even if marginally) with *FOCUSED* and *LASSET* (see Table 21).

Table 25 Geographic Diversification by the Definition of Economic Regions

Dependent Variable ***Underpricing***	**(1)**	**(2)**	**(3)**	**(4)**
VB	-3.884	-3.707	-3.369	-3.229
	-2.949	-2.913	-3.212	-3.263
BB	-7.887	-7.953	-7.945	-8.131
	-7.499	-7.652	-8.029	-8.153
LSIZE	1.438	1.441	1.293	1.308
	1.465	1.455	1.489	1.495
MRETURN	0.440**	0.435**	0.615**	0.607**
	0.171	0.168	0.252	0.255
VOLUME	-1.444	-1.418	-3.873***	-3.909***
	-1.185	-1.152	-0.619	-0.625
LNCREIF	1.242*		0.042	
	0.641		1.484	
LNCREIF_W		1.259**		0.702
		0.564		1.103
LIQUIDITY	-0.303	-0.354	-0.179	-0.232
	-0.749	-0.746	-0.832	-0.844
DENSITY	-5,401*	-5,625*	-6,931**	-6,831**
	-2,868	-2,831	-3,031	-2,936
HHI_ASSET	5.601*	5.604*	4.718	4.925
	3.216	3.206	3.326	3.279
HHI_GEO_ECO	3.450	3.376	4.050*	4.146*
	2.182	2.149	2.418	2.404
Time Dummies	Y	Y	N	N
Fixed Time Effects	N	N	Y	Y
Constant	-1.128	-0.976	-18.12	-12.97
	-10.58	-10.70	-17.63	-15.31
Observations	104	104	104	104
R-squared	0.269	0.272	0.326	0.327

This table presents Ordinary Least Squares estimation for a cross-section of real estate IPOs that have taken place between 1995 and 2014 in the U.S. The dependent variable is *Underpricing* which is the initial return between the first-trading day closing price and the IPO offer price, adjusted for market returns and expressed as a percentage. The variable of interest is *HHI_GEO_ECO* in column, representing the geographic diversification based on eight economic regions defined by Hartzell et al. (1987). It is calculated as the sum of the squared shares of property size that the IPO company has in each economic region, scaled by 10000, ranging from 0 to 1 with lower value representing higher geographic diversification. *HHI_ASSET* represents the property type diversification which is calculated as the sum of the squared shares of property value that the IPO company has in each property type, scaled by 10000, ranging from 0 to 1 with lower value representing higher property type diversification. *VB* is a dummy variable which equals 1 if the IPO is venture-capital-backed; 0 otherwise. *BB* is a dummy variable which equals 1 if the IPO uses bookbuilding as a pricing technique; 0 otherwise. *LSIZE* is the log-transformed total proceeds of the IPO. *MRETURN* is the three-month cumulative market return before the IPO date, based on the DataStream Market Index. *VOLUME* is measured as the number of IPOs in a certain year divided by the total number of IPOs across the sample period, presented as a percentage. *LNCREIF* is the one-quarter lagged NCREIF Property Index Return. *LNCREFI_W* is the one-quarter lagged NCREIF Property Index Return, weighted by the size of the property assets that the IPO company has in each of the four geographic regions by NCREIF definition, which are East, West, South and Midwest. *LIQUIDITY* is the primary market liquidity measured by the number of properties sold in the IPO year as a percentage of the total outstanding properties that year. *DENSITY* measures the state-level IPO density which is, for one year, the number of IPOs that headquartered in the state divided by the population in this state, weighted by the size of the property assets that the IPO company has in each of the states. Time dummies are included for estimations in column (1) and (2). One time dummy is

created for every 3-year window. Time fixed effects are controlled in column (3) and (4). T-statistics are corrected for robustness and presented below the coefficient estimates. ***, **, * denote significance at 1%, 5% or 10% respectively.

5.3.2 Robustness Tests

Table 24 reports our estimation results when both *HHI_GEO* and *HHI_ASSET* are included in the regressions. Focusing first on column (1), the estimated coefficient on *LNCREIF* remains positive and significant at the 5 percent level. Other than *MRETURN*, the remainder of the control variables are not individually significant, once again suggesting that classic theories can hardly account for the initial returns of real estate IPOs, at least in the U.S.. However, greater *DENSITY* remains predictive of lower first-day returns. The estimated coefficients of *HHI_GEO* and *HHI_ASSET* are positive and significant at the 10 percent level or higher, confirming the results obtained for geographic and property type diversification separately.

NCREIF produces total return indices for 'core' properties for a number of geographic segments, including total returns on core properties located in four geographic regions: East. West, South, and Midwest. Core NCREIF properties are existing assets that are fully leased, or nearly so, and located in a major metropolitan area. To create *LNCREIF_W*, we weigh the total returns in these four NCREIF regions by the distribution of the company's IPO assets across these four regions. We replace *LNCREIF* with *LNCREIF_W* in columns (2) and (4) of Table 24. Both the magnitude and the statistical significance of the coefficient estimate is very similar to *LNCREIF*, indicating that the overall impact of private market return on real estate IPOs is not affected by the geographic distributions of the property portfolios. Higher values of *HHI_GEO* and *HHI_ASSET* remain highly predictive of greater initial returns.

In columns (3) and (4), we report results using annual time fixed effects in place of dummies for three-year windows. Despite the loss of degrees of freedom to the small sample, several results are noteworthy. First, NCREIF returns, both weighted and unweighted, no longer

have a significant effect on IPO initial returns, suggesting that annual time fixed effects better control for time variations in NCREIF PPI returns. Second, the estimated coefficients on *VOLUME* are negative and significant in models (3) and (4). In other words, a high concentration of IPOs in a given year is associated with lower initial returns. This also supports the information spillover explanation by Altı (2005). The estimated coefficients on *HHI_GEO* remain positive and significant at a 5% level. However, the statistical significance of *HHI_ASSET* is decreased to 10% compared to results in columns (1) and (2). We also notice that the R-squared of the fixed time effects models are approximately 5% higher than models using 3-year time dummies.

To examine whether the negative effect of the geographic diversification on IPO initial returns is driven by the investor base channel, as we have proposed, rather than by the underlying economics, we replace the *HHI_GEO* with *HHI_GEO_ECO*, which is the geographic Herfindahl index based on eight economic regions, and re-estimate the models reported in Table 24. These results are reported in Table 25. The estimated coefficients on the control variables are not very statistically different from those reported in Table 24. The negative effect of asset type diversification also remains similar to those in Table 24. Similarly, the influence of asset-type diversification is reduced when the annual time fixed effects are used. As to *HHI_GEO_ECO*, no or very weak (when time fixed effects are controlled) impact is found, suggesting that none or very few of the results on the relationship between the geographic diversification and IPO valuation are driven by the underlying economies, reinforcing the investor base argument.

One concern is that the initial return could be driven by the diversification discount effect. According to the diversification literature discussed in Section 5.1, investors tend to overvalue more focused REITs, indicating the tendency for investor-driven initial returns after the listing. In other words, the positive effect of concentration might be due to the after-market

trading. To test whether the positive effect of *HHI_GEO* is transmitted via the investor base channel rather than the diversification discount channel, we divide the initial returns of IPOs into pre- and after-market returns. Specifically, the pre-market return is the difference between the IPO offer price and the opening price of the first trading day and the after-market return is the difference between the opening and closing prices of the first trading day. We re-run the models in Column (1) of Table 24 on both pre- and after-market initial returns as well as their market-adjusted values. The results are presented in Table 26. We can see that the results on control variables and *HII_GEO* are consistent with the main results when the pre-IPO initial returns and the market-adjusted pre-IPO initial returns are considered (Column (1) and (3)). However, no significant relationships are found for the after-IPO initial returns. This finding implies that it's the concentration/diversification has an impact the IPO initial return by affecting pre-IPO pricing via the investor base channel rather than the after-market trading via diversification discount channel.

Table 26 The Effect of Geographic Diversification on pre- and post-IPO Initial Returns

Dependent Variable:	*Pre-IPO IR*	*After-IPO IR*	*Adj Pre-IPO IR*	*Adj After-IPO IR*
	(1)	(2)	(3)	(4)
VB	-3.398*	-0.0881	-2.825*	-0.297
	-1.845	-1.406	-1.638	-1.528
BB	-12.66	2.008	-12.97	1.5
	-8.575	-1.463	-8.632	-1.598
LSIZE	2.557***	-0.0428	2.589***	-0.0232
	0.545	-0.324	0.548	-0.343
MRETURN	0.176*	0.0417	0.182*	0.0452
	0.0933	0.0471	0.0935	0.0508
VOLUME	-1.466**	0.348	-1.439*	0.424
	-0.727	0.304	-0.731	0.324
DENSITY	-3,500*	-412.6	-3,471*	-196.1
	-2,074	-871.8	-2,050	-930.7
LNCREIF	0.795**	0.088	0.812**	0.29
	0.31	0.164	0.31	0.185
LIQUIDITY	0.668	-0.11	0.644	-0.164
	0.471	-0.186	0.47	-0.192
HHI_ASSET	1.951	0.669	1.925	0.376
	2.632	1.491	2.669	1.581
HHI_GEO	3.712*	-0.797	3.779*	-0.965
	1.969	-0.812	1.961	-0.904
Time Dummies	Y	Y	Y	Y
Constant	7.671	-4.328	7.587	-4.647
	10.89	-3.396	10.97	-3.744
Observations	97	97	97	97
Adj R-squared	0.428	0.129	0.432	0.116

This table presents Ordinary Least Squares estimation for a cross-section of real estate IPOs that have taken place between 1995 and 2014 in the U.S. The dependent variable in Column (1) and (3) is *Pre-IPO IR* which is the return between the offer price and first-trading day opening price and its market-adjusted form (*Adj Pre-IPO IR*), respectively. The dependent variable in Column (2) and (4) is *After-IPO IR* which is the return between the first-trading day opening and closing prices and its market-adjusted form (*Adj Pre-IPO IR*), respectively. *HHI_GEO* represents the geographic diversification which is calculated as the sum of the squared shares of property size that the IPO company has in each state, scaled by 10000, ranging from 0 to 1 with lower value representing higher geographic diversification. *HHI_ASSET* represents the property type diversification which is calculated as the sum of the squared shares of property value that the IPO company has in each property type, scaled by 10000, ranging from 0 to 1 with lower value representing higher property type diversification. *VB* is a dummy variable which equals 1 if the IPO is venture-capital-backed; 0 otherwise. *BB* is a dummy variable which equals 1 if the IPO uses bookbuilding as a pricing technique; 0 otherwise. *LSIZE* is the log-transformed total proceeds of the IPO. *MRETURN* is the three-month cumulative market return before the IPO date, based on the DataStream Market Index. *VOLUME* is measured as the number of IPOs in a certain year divided by the total number of IPO across the sample period, presented as a percentage. *LNCREIF* is the one-quarter lagged NCREIF Property Index Return. *LIQUIDITY* is the primary market liquidity measured by the number of properties sold in the IPO year as a percentage of the total outstanding properties that year. *DENSITY* measures the state-level IPO density which is, for one year, the number of IPOs that headquartered in the state divided by the population in this state, weighted by the size of the property assets that the IPO company has in each of the states. Time dummies are included for all estimations. One time dummy is created for every 3-year window. Time fixed effects are controlled in columns (3) and (4). t-statistics are corrected for robustness and presented below the coefficient estimates. ***, **, * denote significance at 1%, 5% or 10% respectively.

Table 27 Moderation Effect of the Deadweight Cost Indicators

Dependent Variable: ***Underpricing***	**(1)**	**(2)**	**(3)**	**(4)**
VB	-3.888	-3.569	-1.830	-1.712
	-3.343	-3.761	-2.401	-2.889
BB	-7.294	-7.209	-6.990	-6.839
	-8.714	-9.289	-8.474	-9.089
LSIZE	1.558	1.405	1.554	1.389
	1.379	1.432	1.348	1.385
MRETURN	0.514***	0.675***	0.493***	0.661***
	0.173	0.250	0.168	0.248
VOLUME	-1.48	-4.047***	-1.566	-4.010***
	-1.162	-0.642	-1.259	-0.641
DENSITY	-5,593*	-7,320**	-4,280	-6,347**
	-2,820	-2,947	-2,818	-2,923
HHI_ASSET	8.197**	7.178*	9.646***	8.360**
	3.510	3.680	3.558	3.640
HHI_GEO	19.54***	18.09**	17.21**	16.02**
	7.276	7.473	7.133	7.604
LNCREIF	2.446**	0.637	1.037**	-0.676
	0.947	1.208	0.502	-1.399
LIQUIDITY	-0.127	-0.106	1.203	1.006
	-0.719	-0.842	0.901	1.127
HHI_GEO X LNCREIF	-5.045**	-4.335*		
	-2.278	-2.390		
HHI_GEO X LIQUIDITY			-3.430*	-2.914
			-1.896	-2.031
Time Dummies	Y	N	Y	N
Fixed Time Effects	N	Y	N	Y
Constant	-9.477	13.55	-11.48	11.45
	-12.41	12.72	-11.72	12.65
Observations	104	104	104	104
R-squared	0.312	0.362	0.313	0.362

This table presents Ordinary Least squares estimation for a cross-section of real estate IPOs that have taken place between 1995 and 2014 in the U.S. The dependent variable is *Underpricing* which is the initial return between the first-trading day closing price and the IPO offer price, adjusted for market returns and expressed as a percentage. The variables of interest are *HHI_GEO X LNCREIF* and *HHI_GEO X LIQUIDITY* which are the interaction terms between *HHI_GEO* and *LNCREIF* and *LIQUIDITY* respectively. *HHI_GEO* represents the geographic diversification which is calculated as the sum of the squared shares of property size that the IPO company has in each state, scaled by 10000, ranging from 0 to 1 with lower value representing higher geographic diversification. *LNCREIF* is the one-quarter lagged NCREIF Property Index Return. *LIQUIDITY* is the primary market liquidity measured by the number of properties sold in the IPO year as a percentage of the total outstanding properties that year. *HHI_ASSET* represents the property type diversification which is calculated as the sum of the squared shares of property value that the IPO company has in each property type, scaled by 10000, ranging from 0 to 1 with lower value representing higher property type diversification. *VB* is a dummy variable which equals 1 if the IPO is venture-capital-backed; 0 otherwise. *BB* is a dummy variable which equals 1 if the IPO uses bookbuilding as a pricing technique; 0 otherwise. *LSIZE* is the log-transformed total proceeds of the IPO. *MRETURN* is the three-month cumulative market return before the IPO date, based on the DataStream Market Index. *VOLUME* is measured as the number of IPOs in a certain year divided by the total number of IPOs across the sample period, presented as a percentage. *DENSITY* measures the state-level IPO density which is, for one year, the number of IPOs that headquartered in the state divided by the population in this state, weighted by the size of

the property assets that the IPO company has in each of the states. Time dummies are included for estimations in column (1) and (3). One time dummy is created for every 3-year window. Time fixed effects are controlled in columns (2) and (4). t-statistics are corrected for robustness and presented below the coefficient estimates. ***, **, * denote significance at 1%, 5% or 10% respectively.

5.3.3 Moderation Effect of Deadweight Cost

We report the results of testing the second hypothesis in Table 27. Columns (1) and (2) report results on the interactions between geographic diversification measured at the state level (*HHI_GEO*) and private market returns (*LNCREIF*) as an indicator of the deadweight cost, including 3-year time dummies and annual time fixed effects respectively. Along with no significantly different results from previous estimations for the control variables, we find significantly negative coefficient estimates on the interaction terms, supporting the argument that when the private market is more 'sell' friendly, the impact of the geographic diversification on the IPO valuation is weakened, i.e. highly concentrated companies will underprice relatively less as they could sell part of the asset portfolio in the private market if the IPO is not successful. In columns (3) and (4), we use liquidity in the private market as a second indicator of the deadweight cost (*LIQUIDITY*), proxied by transaction turnover in the IPO quarter, and interact it with *HHI*_GEO. Similarly, we find negative coefficients on the interaction terms, significant when 3-year time dummies are included, further supporting the second hypothesis about a moderation effect of the deadweight cost associated with IPOs, when markets are buoyant and liquidity-rich, on the relationship between geographic diversification and IPO initial returns.

LNCREIF and *LIQUIDITY* are the indicators for the overall private market conditions and it is reasonable to question their ability to capture the right level of deadweight cost associated with an IPO company. As market conditions differ by regions, the deadweight cost of an IPO might be sensitive to the geographic portfolio of the issuing company. Therefore, as a robustness test, we construct the weighted state-level turnover by market value and property

numbers for each IPO company and replace *LIQUIDITY* with the alternative measures in the estimations in Table 27. The quarterly state-level transaction data is obtained from NECREIF directly. As the results are very similar to those in Table 27, reinforcing the interacted effect between the deadweight cost and geographic concentration, we do not report them here.

5.4 Summary

The listed real estate sector has generally experienced low levels of IPO underpricing relative to industrial companies. Moreover, REIT IPOs have produced negative average initial returns during some time periods, especially in the U.S. The findings in this study suggest no or very weak explanatory power of the classic theories on REIT IPOs, in agreement with the majority of real estate IPO studies. Therefore, we propose a new approach. Consistent with García and Norlib (2012), we find evidence that the share prices of more geographically focused firms, with an arguably smaller investor base, need to be underpriced more in order to attract the recognition of and participation from investors, which is critical to the success of the IPO. The measures of both geographic and property type concentration (computed as Herfindahl indexes) are positively and significantly related to IPO initial returns. These geographic concentration results hold only when the HHI measure based on the exact asset holdings is used, indicating that the HHI measure is a more appropriate measure of geographic concentration/diversification.

The results also support the deadweight cost theory of Chan et al. (2009), who argue that when the going public entity can efficiently sell the portfolio properties in the parallel private market if the IPO fails, the issuer has less incentive to underprice and may even overprice the shares. Note that the deadweight cost theory does not require an assumption of information asymmetries either. Because the investor base of an IPO firm increases with increasing geographic diversification, selling underlying properties in the parallel private market becomes easier, leading to lower, or even negative, initial returns.

More interestingly, we find that the deadweight cost of an IPO weakens the positive effect of geographic concentration on it first-day return. In other words, a geographically concentrated IPO company would experience relatively lower initial returns if the deadweight cost of IPO failure is low.

Chapter 6 : Conclusion

IPO is one of the most critical steps in a company's lifetime and the puzzles surrounding it warrant a substantial amount of research. The extent of underpricing and the staggering amount of money that the issuers leave on the table in an IPO contradict the "common sense" in modern finance and is constantly a key area of focus among researchers in this field. This thesis focuses on the anomaly of the short-run IPO performance which, despite the extensive research, is still not fully understood, especially for specific industries, such as real estate, and/or countries.

This thesis extends the literature by focusing on relatively unexplored areas in IPO studies: emerging markets, real estate sector and cross-country IPO performance. While entrenched in the well-developed literature, this thesis aims to provide a new macro-perspective on IPO underpricing, complementing the micro-level analysis conducted in previous research by using three unique datasets. Section 6.1 presents a short summary of the three studies and concluding remarks, each followed by its implications. Section 6.2 briefly proposes some potential future research questions.

6.1 Conclusion Recapitulation and Implications

This thesis asks the question as to what extent the economic factors and institutional settings could affect the IPO short-run performance alongside the widely-acknowledged firm- and issuing-level characteristics. We identify macroeconomic factors, rather than focusing on general stock markets or the overall economy, that significantly impact on IPO initial returns: a country's financial integration with the rest of the world, the regional economic openness within a country, and geographic locations of an issuing company's underlying businesses/assets.

Firstly, Chapter 3 identifies a new macroeconomic factor—international financial integration—to be critical to the IPO valuation. The first study is conducted on a sample of around 9000 IPOs across 37 countries, providing the opportunity to examine the impact that country-level institutional settings and, more importantly, their interactions with the financial integration have on the firm-level IPO valuation. The research question is essentially derived from two strands of literature on the relations between financial globalization and corporate finance activities, as well as cross-country IPO underpricing and country institutions. The former identifies a positive effect of a country's financial globalization on the efficiency of the financial intermediation process whereas the latter finds that a group of country-level institutions, especially legal frameworks, affects the IPO valuation alongside firm- and issuing-level characteristics.

This study presents the first empirical evidence of a negative relationship between the level of a country's financial integration and the initial returns of its IPOs. We find that both foreign and domestic IPOs experience improved efficiency in pricing due to the increasing financial integration. This relationship stands through alternative measures of financial globalization, such as the KOF Economic Globalization Index and the Financial Openness Index, and is not applicable only to certain periods of time. Other than the commonly-used OLS method in the IPO literature, hierarchical linear modelling is adopted to deal with the clustering structure and allows for the estimations on actual country-level variables, which is limited in a simple fixed-country effect model.

The results further point out that country institutions, and in particular the legal framework, also have significant impacts on the firm-level IPO valuation. We include five different legal institutions which have all exhibited a negative impact on underpricing. In general, the findings show that when the legal institutional environment is better established, the uncertainty surrounding an IPO is reduced. Finally, we find negative coefficients of all five

interaction terms between financial integration and legal institutions. From one standard deviation below to one standard deviation above the mean of financial integration (2 standard deviation increases), the country institutions suffer more than 50% loss in the magnitude of the impact on underpricing. The findings reveal a moderation effect of international financial integration in the relationship between country institutions and IPO underpricing: increasing financial integration of a country weakens the impact of the institutional settings on IPO valuations.

Three implications are highlighted in this study. Firstly, while the focus in IPO valuations is often placed on the firm- and issuing-level characteristics, the results suggest that macroeconomic conditions and/or the institutional environment can sometimes be neglected. Secondly, the findings provide the issuers and investors with insights into IPO valuations under a wider economic background. As financial integration decreases the cost of IPOs associated with underpricing and increases the capital that the issuing company can raise, it gives issuers incentives to seek more financially-integrated markets for listings. In addition, this dynamic relationship between financial globalization, country institutions and IPO performance is especially informative to issuers considering cross-border listings to either escape from or take advantage of certain institutional characteristics, as well as to foreign IPO investors. Thirdly, these findings indicate a positive role of financial globalization on the efficiency of primary markets, in line with the general argument in the law and finance literature that financial globalization improves domestic financial market efficiency and dissolves the boundaries between different capital markets by driving a convergence of the quality in institutional settings across countries. As emerging markets are more sensitive to the globalization process, this provides profound implications for those policy makers regarding the impact of globalization on domestic financial development as well as corporate activities. While financial globalization helps to improve the efficiency of the domestic market, it also provides domestic

companies with opportunities to choose foreign capital by reducing constraints from institutional settings, e.g. legal frameworks. Therefore, a sustainable development would be an improvement in the institutional settings and legal framework while taking advantage of the globalization process.

Given the findings in Chapter 3, we extend the scope to a single-country study in Chapter 4 where we investigate whether, holding country institutions constant, the globalization process has an impact on the domestic IPO market in emerging markets where there is often heterogeneity in regional openness levels.

To briefly summarize, the argument is as follows: urban economic openness could increase the prices of underlying real estate assets and the profitability of the issuing companies through increased productivity, the Balassa-Samuelson effect, and increased foreign investments into the real estate market. All these channels lead to a reduction in uncertainty surrounding IPO valuations, hence a decreased level of underpricing. To empirically test this relationship, we need a proper measure of urban-level economic openness which also presents a significant variation for estimation purpose, as well as a sample of IPO companies with details on the geographical splits of the operating businesses. The real estate sector in China provides a unique laboratory by which to explore this research question as it meets both the aforementioned requirements. A key challenge in the research design is the construction of the urban economic openness measure at a company level. The commonly used measure for country-level economic openness, foreign trade openness, is modified so that it can be used at a city-level. For each company, this urban economic openness is weighted by the share of land-use right that the company owns in each city to its overall land-use right.

The results show a negative impact of urban economic openness on the level of underpricing. The OLS estimates suggest that a 10% increase in the urban economic openness will reduce underpricing by around 3%. For example, in 2010, the GDP for Nanjing and Dalian

is 513 and 516 billion Chinese Yuan respectively and the total foreign trade for Nanjing and Dalian is 309 and 340 billion Chinese Yuan respectively. With a 10% higher economic openness in Dalian (66% and 60% economic openness for Dalian and Nanjing respectively), issuing companies investing in Dalian would experience 3% less underpricing than those investing in Nanjing, holding the other factors constant. This significant impact holds after addressing potential endogeneity issues using 2SLS estimations and controlling for time dummies. More importantly, the concern that the effect has stemmed from the wider economy rather than foreign trade is eliminated by controlling for regional net GDP levels. Interestingly, some characteristics specific to the Chinese market are also found to have a significant influence on IPO performance: the state-owned companies or the companies listed in Mainland China are found to experience much higher underpricing than private companies or companies listed outside Mainland China. 60-day market return also appears to be a better proxy for the market sentiment, signalling a weaker form of market efficiency than in more developed markets.

This study provides five main implications. Firstly, it suggests that the within-country variance between regional economic conditions (‘urban economic openness’ in this study), can also be critical to the outcomes of IPOs, further providing valuation implications for issuers, underwriters and investors. Specifically, the findings imply that the uncertainty about valuation is lowered if the assets are located in more economic open areas. Secondly, as emerging markets are typically prone to significant heterogeneity in regional economic development, this study provides a new perspective by which to examine the extremely high underpricing in other developing countries. The uncertainty surrounding regional economic conditions, other than the firm- and issuing-level factors, might also be the cause of the significantly high variation in the IPO initial returns in some emerging markets. Thirdly, the findings further inform policy makers in emerging markets that the economic and financial development of a country does not benefit all companies in the same way and the imbalance of regional development could also

impact on corporate finance activities. Fourthly, the significant impact of the state ownership status and 60-day market return in China, which indicates a weak form of efficiency, implies that future research in emerging markets should place a greater focus on the influential political system and government of that country. Finally, by using real estate IPOs as a testing ground, the findings suggest that real asset holdings and their location may expose companies to a greater sensitivity towards macroeconomic factors. This result could be further extended to other corporate finance studies focusing on the effect of real asset holdings used as collateral even for non-real estate companies.

In the final stage of this thesis, Chapter 5 further explores the unique role of underlying assets in IPO valuations. As the relationship between regional trade openness and a company's IPO valuation is essentially transmitted through the location of a company's underlying real estate assets, we investigate the impact of the geographic factor (the third macro-economic determinant in this thesis) on real estate IPO valuations.

We argue that real estate companies with underlying properties presenting a high geographic concentration have a lack of investment base or investor recognition which is critical for an IPO to be successful. As a result, issuers have incentives to underprice more to attract sufficient subscriptions, or even over-subscriptions. By using a new method to measure the detailed geographic concentration/diversification at property-location level based on the classic Herfindahl Index, a positive effect of the geographic concentration of a company's underlying properties on its IPO initial return is identified in the U.S. market. Unlike the improvised measures of geographic diversification used in previous studies, we find that this relationship is only significant when this detailed measurement is used, providing indications for future studies on geographic location. By regrouping the U.S. states into eight economic regions according to their actual economic activities and constructing a new geographic diversification variable based on these economic regions, we also demonstrate that geographic

diversification rather than underlying economy impacts on IPO underpricing. Unlike the overall market return which captures the market sentiment and drives higher initial returns, the market return on the private market has no direct impact on REITs IPOs when the time effect is controlled. However, we find that when the private market is 'selling friendly' (higher market return and turnover), issuers' incentives to underprice IPOs due to high geographic concentration are reduced. This result is not altered by the alternative indicator for the level of deadweight cost—weighted state-level private market turnover, which captures the issuing company's geographic portfolios. In other words, geographic concentration shows a smaller impact on IPO valuation if the real estate companies can sell properties in the private market easily, should the IPO fail. The findings suggest a weakened relationship between the geographic diversification and IPO valuation when the real estate company is associated with lower deadweight cost for its IPO failure.

Three implications can be drawn from this study. Firstly, this study adds a new conceptual approach in real estate markets to explain the anomaly of positive initial returns which is not captured by classic theories assuming information asymmetry. Secondly, this study not only provides issuers and investors with a better understanding of IPO valuations of real estate companies, especially the uniqueness of underlying real estate assets, but also indicates new investment strategies for IPO investors: the valuation is set higher if the underlying assets of the issuing company are more geographically diversified. In other words, there is a much higher likelihood of the investors being rationed to overpriced shares from a more geographically diversified IPO. In addition, private real estate market conditions surrounding an IPO should also be considered. Finally, this study offers researchers the opportunity for further investigation into the role of the underlying assets in IPO events in other industries which hold significant real assets (e.g. utility, energy and transportation industries).

Aside from the key findings supporting the main hypotheses, this thesis also produces some other highly interesting results. As the most commonly used measures for information asymmetry and market sentiment, firm size (*LSIZE*) and market return (*MRETURN*) before IPO are included as control variables throughout the three studies. Although we find a significant and negative effect of *LSIZE* on underpricing in the cross-country dataset, it does not exist in the Chinese and U.S. real estate datasets, indicating that the significant effect of firm size identified on the cross-country dataset might be driven by IPOs from developed countries. In contrast to this, market return consistently shows a significant explanatory power throughout all the datasets. This interesting finding does not come as a surprise considering the recent trend in the literature that more empirical studies report the inability of classic theories on non-western markets. Given that the information-asymmetry-based theories are developed on top of the classic finance theories under the developed or western market regime, it is likely to be distorted when other factors, especially regime-related factors, are considered in emerging markets. While these findings imply that it is questionable to assume a universal explanatory power of classic theories in all markets and sectors, they do, however, strongly support the significance of behavioural arguments when it comes to emerging markets and real estate sectors.

In closing, we have utilized an economic perspective to tackle the research questions in all three studies of this thesis, presenting some previously unseen findings in this extensively researched area. Despite inherent difficulties in empirically establishing certain macroeconomic effects on corporate-level activities, we should not assume that such influences from macroeconomic conditions do not exist.

6.2 Future Research

The extensive literature on IPO short-run performance can seem overwhelming and making new approaches stand out among many other established theories or models can seem

intimidating. However, we cannot neglect the fact that the underpricing puzzle remains unsolved and the studies on the IPO performance carry a great impact. It is now widely agreed that not a single model can account for the IPO initial returns and which model or models are the most appropriate depends on many factors such as industries, markets and time periods. Future studies should focus on the economic significance of different models under different circumstances. With the increasing availability of data, more empirical studies need to be carried out in emerging markets where the consideration of economic conditions and country institutions becomes exceptionally important.

In this section, we briefly summarize some potential questions generated by this thesis for future research, in and beyond the field of IPO. Firstly, although financial integration is found to benefit both domestic and foreign IPOs, whether there is a relative difference between the magnitude of the impact they experience needs to be further investigated. Foreign IPOs are more likely to take place in emerging markets as a result of the financial integration process which allows companies to seek a more transparent or efficient institutional setting in foreign markets. Our next project after this thesis is to carry out a study in an emerging market which treats the foreign IPOs as a treatment group and domestic IPOs as a control group in order to examine the dynamics of how foreign and domestic IPO performance, in the short and long run, might react differently to financial integration.

Secondly, as we find that more-developed country institutions significantly reduce the uncertainty surrounding the IPO, the question should be asked as to whether the post-IPO (short-term and long-term) performance of foreign IPOs, which have gone public in a stronger institutional setting, are better than their domestic rivals.

Thirdly, as we find that financial globalization seems to compensate for the poor country institutions in IPO events, a similar effect of financial globalization and its interaction with institutional settings on other corporate activities can be expected. Since corporate governance

is often heavily influenced by institutional settings, especially in emerging markets, it is natural to investigate the dynamics between the corporate governance in emerging markets, country institutions and financial globalization; a project that we are currently working on.

Finally, the findings in Chapter 4 and Chapter 5 suggest a research direction towards the role of underlying assets in real estate corporate finance. Although the underlying assets bring the real estate sector greater transparency which potentially reduces the agency problems in corporate finance activities, the findings in this thesis suggest that the "non-tradable" and "unmovable" underpinning of the real assets seem to make the real estate sector more susceptible to the regional economic environment.

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