Examination of IPO Mispricing in Four Markets

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Abstract

The apparent anomaly that initial public offerings (IPOs) are mispriced across time and markets has been a focus of academic research for over four decades. Previous studies on the subject have focused on the underpricing of IPOs. Using a sample of 6171 IPOs that were issued from 1995 to 2013 in four markets – the United States (US - 2458 IPOs), Australia (1095 IPOs), China (2199 IPOs) and Malaysia (419 IPOs) – we also find that IPOs are on average underpriced but that a concentration on the average overstates the extent of this underpricing with a significant proportion of IPOs actually being overpriced. In the US, the mean mispricing is 34.90%, and the median is 2.40%, with 35.50% of IPOs being overpriced. In Australia, the mean mispricing is 25.51%, the median is 10%, and 37.70% of IPOs are overpriced. In China, the mean mispricing is 112.10%, the median is 71.40%, and 6.30% of IPOs are overpriced. In Malaysia, the mean mispricing is 1.80%, the median is -17.53%, and 59.42% of the sample IPOs are overpriced.

A wide dispersion in mispricing exists across the four markets. The IPOs range from highly overpriced to extremely underpriced IPOs. We assemble a large number of firm-level and country-level variables to explain the mispricing, and we show how their impacts vary across the range of mispricing and across the four markets. The firm-level factors examined include company characteristics, offer characteristics, issue certification, prospectus disclosure, market sentiment, and institutional characteristics. These factors are found to have a varying impacts across different levels of mispricing.

Country-level variables include institutional quality and economic strength. Our findings suggest that poor institutional quality adds to the uncertainty about the value of the firm and leads to more mispricing.

Our cross-country examination of mispricing is one of the first studies to examine the relationship between a country's economic strength and IPO mispricing. We find that the largest mispricing occurs in developing countries experiencing high economic growth, and that larger economic size reduces mispricing. We further find that, while the country-level characteristics are differentiating factors across our sample markets, they have their greatest explanatory power for moderate levels

of mispricing, and that extreme levels of mispricing are better explained by firm-level factors.

We use the traditional ordinary least squares (OLS) and the more appropriate quantile regression (QR) methods as our methods of examination. The OLS approach focuses on the average impact that the independent variables have on mispricing. In this approach, the latent characteristics of the mispricing distribution, given that it does not follow a normal distribution, remain unexamined. On the other hand, the QR approach allows us to examine the varying effects that the independent variables have at different levels of mispricing due to the asymmetric distribution of returns. The QR approach enables us to identify the impacts of each variable on IPOs at particular levels of mispricing. The QR approach is a robust method which is able to deal with potential heterogeneity in the distribution, as was the case with our sample. We are able to compare the results derived from the median QR with those derived from the traditional OLS to enrich the literature in terms of the analysis of a skewed distribution. The QR method also enables us to examine different segments of the distribution of mispricing, including the tail regions. By doing this we are able to compare the impacts of the explanatory factors on mispriced IPOs that range from extremely overpriced to extremely underpriced.

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Thesis related research outcomes

The following research output has resulted from this thesis:

Journal articles

Bird, R. & Ajmal, H. (2016). Mispricing of Australian IPOs. *JASSA: The Finsia Journal of Applied Finance*, (1), 27-33.

Conference papers

Ajmal, H. (2018, June). The impact of economic size, growth and institutional quality on IPOs mispricing. Paper presented at the 93rd Western Economic Association International (WEAI) Conference, Vancouver, Canada.

Ajmal, H., & Bird, R. (2017, June). A different view on IPO mispricing: Evidence from Australia. Paper presented at the 24th Annual Multinational Finance Society Conference, Bucharest, Romania.

Ajmal, H., & Bird, R. (2017, April). Cross sectional analysis of Australian IPO Returns: A quantile regression approach. Paper presented at the 8th Conference on Financial Markets and Corporate Governance, Wellington, New Zealand.

Ajmal, H., & Bird, R. (2016, October). IPO mispricing in Australia, Paper presented at the 19th Annual Waikato Management School Student Research Conference, Hamilton, New Zealand.

Ajmal, H., & Bird, R. (2015, September). Short-run IPO price behaviour in Australia. Paper presented at the 18th Annual Waikato Management School Student Research Conference, Hamilton, New Zealand.

Working papers

Ajmal, H., Bird, R., & Hou, G. (2018). IPO mispricing across countries: Examining the impact of institutional quality and economic strength, Working paper.

Ajmal, H., & Bird, R. (2018). A different view on IPO Mispricing: Evidence from Australia, Working paper.

Ajmal, H., Bird, R., & Hou, G. (2018). Re-examining mispricing in Chinese IPOs: A quantile regression approach, Working paper.

Ajmal, H., Bird, R., & Hou, G. (2018). Mispricing of Malaysian IPOs: A quantile regression approach, Working paper.

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Chapter 1: Introduction

1.1 Introduction

An initial public offering (IPO) occurs when a business entity first approaches the market to raise equity capital. This event is of significance to several important participants: the issuer, the investors and a number of institutions that play an important role (such as the underwriter), and eventually the market. An IPO offers the opportunity to raise capital to finance the expansion of an entity and/or for the current owners to realise on their investment. An IPO typically involves a financial institution that assists in bringing the entity to the market. The financial institution assists in reducing the cost of acquiring information, and in transacting and facilitating the issuing of equity. In particular, with respect to IPOs, they provide services such as assisting in setting the price, providing information to potential purchasers and ensuring that all regulatory requirements are met. The financial institution also underwrites and markets the shares. The investors seek to profit from the purchase and (re)sale of the shares. The market in which the IPOs are offered and traded facilitates the process of raising equity by providing a regulatory and institutional framework under which the three parties operate. Importantly, the sale of the shares involves the use of scarce capital resources and their deployment to contribute to the development of the economy.

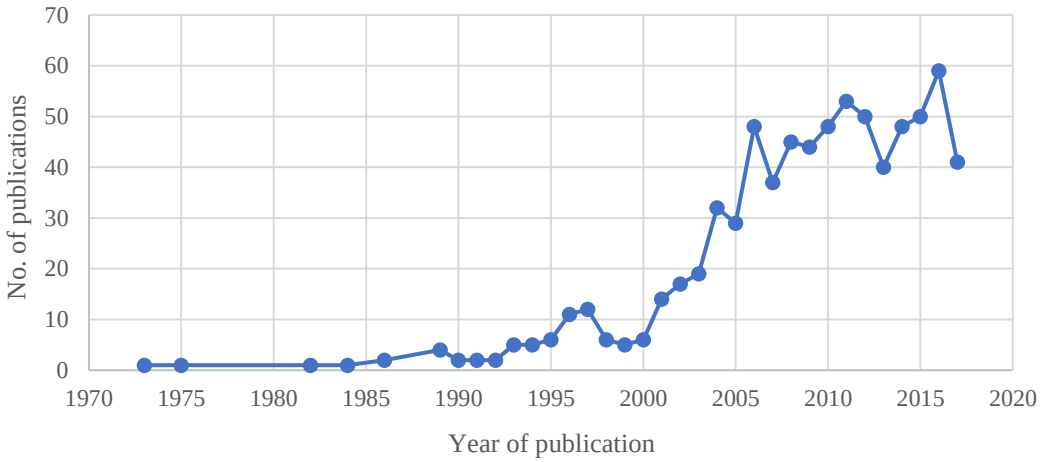
When IPOs are sold to investors, they are often found to be traded on a different price in the secondary market than the price at which they are first offered. This is referred to as mispricing. The mispricing is the difference between the price at which issuers offer their IPO shares for sale and the price at which those shares are traded in the secondary market. Since mispricing is usually calculated on the first trading day, it is also called first day returns. The phenomenon of mispricing has been observed across time and markets. Previous studies (e.g. Loughran, Ritter & Rydqvist, 1994; Autore, Boulton, Smart & Zutter, 2014) report the average mispricing to be positive, which is referred to as underpricing. Empirical studies spanning more than four decades report that the IPOs are persistently mispriced across markets, and that the average mispricing ranges from 11.90% to 29.6% in Australia, 6.2% to 78.5% in Brazil, 50.17% to 948.59% in China, 1.82% to 99.25% in Malaysia, 28.42% to 50.60% in Taiwan and 7.27% to 34.80% in the United States

(US). These sizable first day returns made by the IPO investors have been an intriguing phenomenon for academics, and they have been consistently investigated in the literature.

1.2 Background

The early evidence that the IPO stocks are offered below the price at which they are subsequently sold in the secondary market dates back to a Securities and Exchange Commission (1971) study that reports positive mean initial returns on newly issued common stocks. Since then, studies have continued to find IPO mispricing. Figure 1.1 shows the frequency of studies that have examined the mispricing of IPOs across time.[1]

Figure 1.1: Frequency of publications by years



The first academic publication on the topic of IPO mispricing occurred in 1973. This was a paper by Dennis Logue titled "On the Pricing of Unseasoned Equity Issues: 1965-1969", in which he studied 250 IPOs issued from 1965 to 1969. A simple text search of the article reveals that the words "underpricing" and "overpricing" appear six times and one time respectively in the article, and instead of using the term "initial public offering" he uses the term, "first public offering of common stock". The second article found in the search was Ibbotson's (1975) study titled "Price Performance of Common Stock New Issues" in which the author

[1] Data and methods used to create Figure 1.1 are described in Appendix A.

examines a sample of 120 IPOs issued from 1960 to 1969. Ibbotson finds mean initial positive returns of 11.4%. He refers to mispricing as “underpricing”, a term which appears seven times in the article. The graph of the publications on IPO mispricing shown in Figure 1.1 suggests that interest in IPO mispricing grew during the mid-90s, followed by a surge in the number of publications on the topic from 2001 onwards. The highest number of articles published was 59 in 2016.

A summary of the mispricing evidence is provided in Table 1.1 that shows that IPO mispricing occurs across time and markets. Overall, average mispricing is found to be positive, and the highest mispricing has been observed in China (157% to 378.4%) and Malaysia (99.25%). The lowest mispricing has been observed in the UK (11.41%) and Germany (9.2%). The other descriptive statistics such as median, minimum, maximum and skewness measures are not widely reported in the literature.

The levels of IPO mispricing reported in previous studies show a huge difference between the mean and median levels of mispricing. For example, Lee, Taylor and Walter (1996) report a 16.41% mean and a 10% median for mispricing in Australia, Wang (2005) reports a 271.90% mean and a 123.90% median in China, Kooli and Suret (2001) report a 20.57% mean and a 5% median in Canada, Ahmad-Zaluki, Campbell and Goodacre (2007) report a 95.20% mean and a 76.50% median in Malaysia, Lin, Pukthuanthong and Walker (2013) report a 55.83% mean and a 36.19% median in South Korea, and Lee and Kuo (2010) report a 28.42% mean and a 17.89 % median in Taiwan. For the US, Miller and Reilly (1987) report a 9.87% mean and a 2.78% median whereas Chang et al. (2014) report a 13.36% mean and a 6.27% median. Given the skewness observed in the distribution of first day returns, it is somewhat surprising that this issue has received little attention in the literature. In addition, wherever the minimum level of mispricing is reported, it has been found to be negative. A comparison between the minimum level of mispricing and the median level of mispricing indicates that a proportion of the IPOs are overpriced, which is also a subject which has received little attention in the literature.

Research that attempts to explain why IPOs are mispriced and yield positive first day returns on average refer to this phenomenon as an anomaly. The fact that IPO shares are sold at prices that are lower than their initial prices has generated a large

Table 1.1: Mispricing across time and markets

Country	Study	Period	Mean (%)	Median (%)	Min (%)	Max (%)	Skewness
US	Miller & Reilly (1987)	1982 – 1983	9.87	2.78	-21.07	124.94	2.54
Hong Kong	McGuinness (1992)	1980 – 1990	17.60				
US	Michaely & Shaw (1994)	1984 – 1988	7.27		-29.87	136.81	
Australia	Lee et al. (1996)	1976 – 1989	16.41	10.00	-50.00	240.00	
Germany	Ljungqvist (1997)	1970 – 1993	9.20				
Japan	Hamao, Packer & Ritter (2000)	1989 – 1995	15.70				
Malaysia	Jelic, Saadouni & Briston (2001)	1980 – 1995	99.25	79.04	-65.80	396.96	
Canada	Kooli & Suret (2001)	1991 – 1998	20.57	5.00			2.15
Belgium	Engelen (2003)	1996 – 1999	14.32				
China	Wang (2005)	1994 – 1999	271.9	123.90	-50.40	4,900.00	
UK	Hill & Wilson (2006)	1991 – 1998	11.41		-21.59	153.55	
Malaysia	Ahmad-Zaluki et al. (2007)	1990 – 2000	95.20	76.50	-53.80	400.00	
China	Guo & Brooks (2008)	1984 – 2005	378.4	119.37	-82.40	38,300.00	
France	Chahine (2008)	1997 – 2000	22.70	9.80			
Taiwan	Lee & Kuo (2010)	1997 – 2007	28.42	17.98	-57.92	503.85	20.35
China	Lee, Hsieh & Yen (2010)	1993 – 2005	144.42	108.16	-86.90	3,283.33	786.36
Brazil	Boulton, Smart & Zutter (2010)	2000 – 2004	13.70	13.90			
China	Gao (2010)	2006 – 2008	157.00		0.00	538.00	
India	Hopp & Dreher (2013)	1988 – 2005	96.74		26.68	534.82	
Singapore	Hopp & Dreher (2013)	1988 – 2005	22.43		-2.22	55.71	
South Korea	Lin et al. (2013)	1991 – 2011	55.83	36.19			
New Zealand	Lin et al. (2013)	1991 – 2011	17.95	31.51			
Indonesia	Husnan, Hanafi & Munandar (2014)	1995 – 2012	23.06	15.42	-71.78	175.79	
Greece	Autore et al. (2014)	1998 – 2008	58.30				
Taiwan	Chang, Chen, Kao & Wu (2014)	2006 – 2010	50.60	34.00	-10.00	233.33	
US	Chang et al. (2014)	2006 – 2010	13.36	6.27	-29.55	161.25	
Australia	Bird & Ajmal (2016)	1995 – 2013	25.51	8.62			4.70

1. The table summarises empirical evidence of mispricing across markets and time.

number of studies which have proposed a number of explanations. This is evident from the word-cloud[2], shown in Figure 1.2, which is based on the keywords of the articles that examine the mispricing phenomenon. The word-cloud shows that most of the research relates to: IPO, underpricing, initial, public, and offerings. Less prominent terms include information, corporate, performance, governance, and venture.

Figure 1.2: Map of words that appear most frequently in the articles' keywords

Figure 1.3 shows the word-cloud of the words that appear most frequently in the abstracts of the articles. The most frequent words are not much different to those appearing in Figure 1.2. The most commonly used words are IPOs, firms, market, underpricing, public, performance and results. Words that appear less frequently in the abstracts include: information, investors, returns, price, equity, venture and capital.

The word-clouds in Figures 1.2 and 1.3 depict the overall focus of the literature regarding IPOs. The focus revolves mainly around the following contexts: the underpricing of IPOs, capital, commitment, ex-ante uncertainty, information asymmetries surrounding IPOs, the relationship between IPO mispricing and underwriters, the role of venture capitalists in IPO mispricing, corporate governance and IPO performance, institutional settings and IPO mispricing, signalling theory, prospectus disclosure and market performance. The leading

[2] The process of creating the word-cloud is described in Appendix A.

topics are the underpricing of IPOs, and many theories that attempt to explain this phenomenon. Particular theories may be more applicable to some contexts than others, but they are not mutually exclusive. These theories are discussed in Chapter 2.

Figure 1.3: Map of words that appear most frequently in the articles' abstracts

1.3 Motivation and research questions

The above discussion highlights some gaps in the mispricing literature which led to the formation of our research questions. First, the fact that the mean of the IPO mispricing which has always been found to be positive has led to a focus on underpricing. This is evident from the fact that underpricing is frequently used to refer to IPO mispricing. However, a number of IPOs are also overpriced, which can be observed from the minimum first day returns reported in Table 1.1. This indicates that a significant proportion of IPOs are overpriced. At the same time, there is a huge difference between the mean and the median first day returns. These observations suggest that the distribution of the first day returns might not be normal and this leads us to our first research question.

Research question 1: What is the distribution of mispricing across the four markets?

Second, the focus of the literature has been on explaining why IPOs are underpriced. Whereas, we find that a proportion of IPOs are overpriced. To address this, we divide mispricing distributions into various levels based on the direction of

the mispricing. IPOs with negative first day returns are referred to as overpriced IPOs; IPOs with positive returns are referred to as underpriced IPOs and IPOs that have close to zero returns are called fairly priced IPOs.[3] In order to examine the factors that impact the levels of mispricing we put forward our second research question.

Research question 2: What are the factors that contribute to mispricing at different levels of mispricing?

Third, most studies in this area have focused on explaining the mispricing phenomenon through firm-level characteristics such as the characteristics of the firm going public, offer characteristics, the characteristics of the financial institutions associated with the firm and the characteristics of the market where the firm is going public. This is, again, evident from the keywords associated with the articles and from other words frequently used in the articles. It is only recently that researchers have started to examine the effects of country characteristics on mispricing (e.g. Autore et al., 2014; Boulton, Smart & Zutter, 2017; Engelen & van Essen, 2010; Hopp & Dreher, 2013). This leads to our third research question.

Research question 3: How do a country's characteristics impact IPO mispricing?

This thesis addresses these questions by examining the mispricing of IPOs in four markets: the US, Australia, China and Malaysia. The reason for selecting these markets is that they are at different stages of development, they have different regulatory and institutional frameworks, and different levels of economic strength and institutional quality. The US market also serves as a benchmark case and studies on the other three countries are compared with US studies. Morgan Stanley Capital International (MSCI) Market classification classifies the US and Australia as developed markets. China and Malaysia are classified as secondary emerging (under-developed) and advanced emerging (developing) markets, respectively. The classification is primarily based on the regulatory environment and the market-oriented practices prevalent in each country.

[3] We define fairly priced IPOs as those which have returns between -0.0001% to +0.0001%.

The dominant method of pricing IPOs in the US is the book building method.[4] In Australia and Malaysia the dominant method of pricing IPOs is the fixed price method. The Chinese IPO market has experienced a transition from the fixed price method to the book building method. The phases of this transition are discussed in Section 6.1. Firms going public in the US hire financial institution(s) to underwrite their IPOs, whereas in Australia, firms going public are found not to underwrite their issues, and may only use a financial institution to manage the issue. On the other hand, Chinese firms were required to hire government-owned financial institutions as underwriters. This practice changed to the hiring of private financial institutions as underwriters when the book building method of pricing was adopted in 2005. In Malaysia, firms listing in the ACE (Access, Certainty and Efficiency) market are required to hire a Bursa Malaysia-nominated financial institution as an underwriter. The institution also assumes a role as an adviser for a period of three years after the company is listed in the ACE Market.

The four countries also differ in terms of their institutional quality, a characteristic which is measured using a set of six indicators developed by Kaufmann, Kraay and Mastruzzi (2015) (i.e. control of corruption, government effectiveness, political stability, regulation quality, voice and accountability and rule of law). These measures show that Australia has the highest level of institutional quality across all six measures, followed by the US, Malaysia and China. In terms of economic strength (measured as GDP per capita), Australia and the US rank highest. On the other hand, China has the highest level of economic growth (measured as the percentage growth in GDP) followed by Malaysia, Australia and the US.

This thesis examines the mispricing of IPOs at both the intra-country and inter-country levels to identify the factors that cause variations in the mispricing of the IPOs. The factors that we include in the examination are the characteristics of the

[4] In the book building method the underwriter sets the offer price after assessing the non-binding offers submitted by the investors and demand for the shares. Under the fixed price mechanism the IPO shares are sold at a price predetermined by the issuer and the underwriter. The other methods of going public are auction and hybrid offers. In the auction method, investors submit binding orders stating a specific number of shares at a certain offer price. After the submission of the orders, an auction pricing mechanism is used to assign the shares. The hybrid offer method is a combination of the fixed price, book building and auction methods.

firm that is going public and the characteristics of the country where the firm is going public.

In addition to using the traditional approach used for examining the mispricing of IPOs (i.e. the ordinary least squares (OLS) method), we use the quantile regression (QR) approach, developed by Koenker and Bassett (1978), to conduct our analysis. The QR approach has several advantages over the OLS method. The key difference between the two approaches is that they use different distributional reference points to examine the impacts of firm- and country-level factors on mispricing. The OLS method explores the effects of explanatory factors on mean mispricing values. The estimates that are obtained from the OLS approach are assumed to be fixed across the distribution of IPO returns. In addition, the OLS method has to meet the condition of normal distribution for its estimates to be reliable. In contrast, the QR approach can examine the effects of factors on multiple quantiles of mispricing distributions. Therefore, the QR allows us to examine various levels of mispriced IPOs, including those that lie within extreme value ranges. Hence, we are able to differentiate between the impacts that the explanatory factors have on the overpriced and the underpriced IPOs.

1.4 Contribution of the thesis

By addressing the research questions that emerged from the literature on mispricing, this thesis makes the following contributions to the literature. Firstly, we show that IPOs are mispriced by varying magnitudes across markets. The magnitudes of mispricing are not only different across the markets but also within markets. While IPOs are on average underpriced, the levels of magnitude vary within the markets (i.e. there are overpriced IPOs, fairly priced IPOs and underpriced IPOs). Secondly, we examine the various levels of IPO mispricing using both the OLS and the QR approaches. The use of the QR approach allows us to examine the different levels of mispricing, that is, overpriced IPOs, fairly priced IPOs and underpriced IPOs, and to differentiate between the impacts that the independent variables have on mispricing in these categories. We show that the relationship between mispricing and the explanatory factors are not monotonic, which is not captured by the OLS method. Instead, the relationship differs across different levels of mispricing. Third, we show that the different levels of mispricing are explained by the country characteristics – that is, institutional quality and

economic strength. Our cross-country study is the first to examine the relationship between a country's economic strength and mispricing. Lastly, the book building method of pricing IPOs is found to reduce the level of mispricing. This is particularly apparent when one examines the connection between mispricing and changes to the type of pricing regime used in China.

1.5 Structure of the thesis

The thesis is organised as follows:

Chapter 2 (Literature review) provides a summary of the mispricing evidence across the world and the explanations that are put forward to explain the mispricing phenomenon at both the firm level and the country level.

Chapter 3 (Variables, data and method) discusses the variables used to examine IPO mispricing and the sources used to obtain data for those variables. This is followed by a discussion of the method used to examine mispricing across the four sample countries.

Chapter 4 (the United States) discusses the mispricing of IPOs issued in the US.

Chapter 5 (Australia) discusses the mispricing of IPOs issued in Australia.

Chapter 6 (China) discusses the mispricing of the IPOs in China. This chapter also provides insights into the impact of the book building method of IPO pricing on the mispricing of IPOs in China.

Chapter 7 (Malaysia) discusses the mispricing of IPOs issued in Malaysia.

Chapter 8 (Mispricing and country-level institutional framework) examines the impacts of country-level institutional frameworks on IPO mispricing across the four markets. Country-level institutional framework variables are institutional quality and the economic strength of the country.

Chapter 9 (Conclusion) concludes the thesis by highlighting the major contributions made by this study to the broader IPO literature and identifies directions future research may take.

Chapter 2: Literature Review

2.1 Introduction

The difference between the price at which issuers offer an IPO and the price at which the shares close on the first day of trading is taken as a measure of mispricing. The common finding, across markets and over time, is that IPOs are on average underpriced. The fact that issuers are willing to underprice IPOs and hence seemingly leave large amounts of funds on the table has intrigued researchers for over four decades. The existing literature includes several attempts at explaining the mispricing of IPOs, but little attention has been paid to the fact that a significant proportion of the IPOs are overpriced. This chapter aims to review the existing literature that provides explanations of the phenomenon of IPO mispricing. However, since we examine mispricing in four individual markets, the studies that examine those markets are reviewed in their respective chapters.

2.2 Theories that explain IPO mispricing

The process of going public involves the participation of four parties: the issuer, investors, financial institutions (such as those acting as underwriter/s) and the market. Issuers approach markets to raise capital and investors seek investment opportunities to yield returns. Financial institutions help ensure the IPO is fully subscribed by underwriting, marketing and managing the offer. The market is an institution that provides regulations and a framework to facilitate the process of going public. When shares are mispriced, a question arises: Which of the IPO parties gain and which of the participants lose? The literature contains various theories which attempt to answer this question. Ibbotson (1975) was the first to provide plausible reasons for why money is left on the table. Ibbotson provides the following arguments to possibly explain the mispricing phenomenon:

- The US securities regulations encourage underwriters to offer the IPO shares below their expected value.
- Issues are mispriced to ‘leave a good taste in investors’ mouths’ so that subsequent offerings from the same issuers will sell at higher prices.
- Underwriters deliberately misprice shares to benefit investors by exploiting inexperienced issuers.

- Underwriters misprice IPOs in case their underwriting spread does not sufficiently cover the risk they are taking.
- There may be a mechanism under which investors compensate issuers for selling the issue at a discount.
- Issuers and underwriters misprice IPOs as insurance against litigation risk.

Ibbotson states that these are inadequate explanations for the observed mispricing, as each of them involves either unknown legal constraints, unnecessarily complicated indirect compensation schemes, or irrational behaviour by the parties involved in the IPO process. The sections that follow discuss the various theoretical explanations that have been put forward to explain the phenomenon of mispricing. One explanation that receives significant empirical support is based on asymmetric information theory. Ljungqvist (2007) concludes that information asymmetry has a first order effect on mispricing. Other explanations of the mispricing phenomenon are based on: insurance against litigation (Tinic, 1988), wealth redistribution (Ibbotson & Ritter, 1995), regulatory constraints (Ibbotson & Ritter, 1995), ownership dispersion (Booth & Chua, 1996) and 'hot issues' market (Ritter, 1984). It should be noted that most of these explanations were developed based on the US IPO market, and may not be applicable in other markets as the features of the US IPO market may be different from others. The rest of this section discusses the explanations listed above.

2.2.1 Information asymmetry

Information asymmetry is said to be the key underlying reason for the average positive difference between IPOs' offer prices and market prices. Information asymmetry refers to different levels of information possessed by three parties: the issuer, the investors and the underwriter(s).

2.2.1.1 The winner's curse model

The winner's curse model developed by Rock (1986) suggests that underpricing IPOs is a rational move by the issuer in an environment which is informationally asymmetric for different types of investors. Investors are categorised based on their levels of information about true value of the firm. Informed investors will have superior information about the value of the firm while uninformed investors' information is restricted to mere knowledge of probability distribution from which

they assess firm's value. As a result of this difference in the level of information, the informed investors will compete with the uninformed investors for good issues. Informed investors will only subscribe to issues which are attractively priced, whereas uninformed investors will not be able to discriminate between good and bad issues. This causes the winner's curse for the uninformed investors as they will face competition from the informed investors for good issues and this will decrease the probability of their being allocated good issues. On the other hand, when bad issues are available, uninformed investors will face no competition and will end up purchasing disproportionate levels of overpriced stocks. This implies that the fact that the IPOs are on average underpriced is of no significance to uninformed investors as there is a high probability that they will not get the subscribed number of underpriced IPOs and will get 100 per cent of the overpriced IPOs. For such uninformed investors, the average returns they yield from investing in IPO shares will be negative. If uninformed investors expect to lose money they will withdraw from the IPO market and the only investors left to participate in IPO activity will be informed investors. Rock (1986) argues that informed demand is not sufficient to subscribe to all the shares, even when the shares are attractively priced. Therefore, the IPO market is dependent on the continuous participation of uninformed investors. Thus, to encourage uninformed investors to participate in the market, issuers leave some money on the table to ensure their continuous participation.

The empirical examination of winner's curse by Beatty and Ritter (1986) finds average mispricing of 18.80%. They suggest two explanations for the positive mean return. First, they demonstrate that the positive returns are caused by the information asymmetry that exists between the investors. Second, they argue that the issuers hire financial institutions to underwrite the IPOs to ensure subscription, as the financial institutions are known to the investors whereas the issuers are new to the market. Therefore, there is an equilibrium relation between ex-ante uncertainty and mispricing which according to Beatty and Ritter (1986) is enforced by underwriters. Michaely and Shaw (1994) find evidence supporting the existence of winner's curse attributing higher mispricing to greater information asymmetry. They show that when investors know they do not have to compete with informed investors, the mispricing disappears. They also show that if the underwriter has a

good reputation, this reduces mispricing as the IPOs underwritten by reputable financial institutions experience less mispricing.

In summary, the winner's curse model suggests that issuers deliberately misprice IPOs to mitigate information asymmetry among investors and attract uninformed investors to participate in the IPO process. Therefore, if issuers do not want to attract uninformed investors, they do not have an incentive to misprice.

2.2.1.2 The Signalling Model

Signalling model of mispricing states that mispricing is a deliberate action performed by issuers to provide a signal of the true value of firms. This model assumes that information asymmetry is present between the issuers and investors. Issuers, who are better informed about the value of the firm, future cash flows and the associated risks, reveal information about the firm to reduce the information asymmetry. The model was first proposed by Spence (1973) in the context of labour market behaviour. Later, works by Leland and Pyle (1977), Grinblatt and Hwang (1989), Allen and Faulhaber (1989) and Welch (1989) examine the impact of the information revealed by issuers on IPO mispricing.

Leland and Pyle (1977) argue that the information asymmetry between the issuers and investors leads to poor market performance. Therefore, the issuers reduce this information asymmetry by revealing information about their value. One such piece of information is the proportion of ownership stake that the issuers retain in the firm at the time of IPO. Bradley and Jordan (2002) argue that issuers who retain higher proportion of shares at IPO misprice more. For instance, the issuers who retain higher proportions of shares signal the market of their superior knowledge about future cash flows. Welch (1989) argues that mispricing is a result of a signal that an issuing firm sends to the market about the likelihood of profitable returns from investing in the IPO. By intentionally offering shares at lower prices at the IPO, the firms seek higher prices for seasoned equity offerings (SEOs) which compensates for mispricing the initial offering. This implies that in cases when issuers do not intend to go for a seasoned offering, they are likely to underprice less, or may even overprice the IPO. They would do so to maximise proceeds at the time of the initial public offering.

Grinblatt and Hwang (1989) and Allen and Faulhaber (1989) argue that it is the issuer who has the best information about the value of the firm and the issuer wants investors to know about their superior quality. To achieve this, issuers use the low price and size of IPOs as a signal for investors. Their assumptions back Ibbotson's (1975) proposition that IPOs are underpriced to 'leave a good taste in investors' mouth'. When the same issuer sells more shares in subsequent offerings, investors are more willing to subscribe to their offers. Therefore, mispricing becomes a credible signal for investors that the firm is worthy of their investment. This implies that positive mispricing (underpricing) should favour high value firms, as investors will make favourable inferences regarding the subsequent performance of the firms. Similarly, low-value firms that know that the aftermarket performance of their shares will be poor and that they will not be able to recover the money left on the table in the form of underpricing will not be able to afford to price their shares low as a form of signal; on the contrary, they will be inclined towards overpricing their shares.

Like Grinblatt and Hwang (1989) and Allen and Faulhaber (1989) Brennan and Hughes (1991) show that issuers use the offer price as a signal of quality. Their argument is that, by setting a lower offer price, issuers attempt to attract the attention of analysts so that they produce more research reports about their stocks, which acts as an incentive to gain higher brokerage commissions. Thus, by setting the offer price low, issuers signal their high quality, leading to less ex ante uncertainty and lower first day returns. In doing so, high risk firms can attract analysts' attention by setting low offer prices. However, if a lower price disproportionately benefits riskier firms, investors might revise their perceptions of the firm's intrinsic riskiness, resulting in an opposite impact: IPOs priced lower (by riskier firms, who wish to signal quality by increasing investor transaction costs to attract more analyst's coverage) are associated with higher mispricing. It is mostly the underwriter himself / herself who later provides analysts with coverage. Lower pricing translates directly into a wealth transfer from investors/owners to the underwriter (in subsequent commissions).

Consistent with the above mispricing theories, different variables like offer price, offer size, earnings per share forecast and retained ownership are identified as signals from issuers and are found to have significant relationships with IPO

mispricing. For example, Beatty and Ritter (1986) show that firms that retain higher proportions of shares at the time of IPO are more mispriced; Dimovski and Brooks (2004) show that firms that predict higher future cash flows are more mispriced; Gygax and Ong (2011) find a positive correlation between offer price and mispricing; and lastly Autore et al. (2014) show that smaller offer size leads to more mispricing.

2.2.1.3 The underwriter's power theory and issue certification

Firms that are going public need underwriting services, such as advice, pricing and distribution. These services are offered by financial institutions, which possess better information about the capital markets and have the expertise needed to sell the issue to the investors. Issuers can obtain value from this role by delegating the underwriter to make the decision about the offer price. Baron (1982) model hypothesises that the underwriters possess superior information about the market, and about pricing IPO shares, and therefore they will choose the second-best price level. They do so to expend less in marketing the offer and ingratiate themselves with their buy-side clients. As a result the IPO is mispriced compared to the first price.

On the other hand, Campbell and Kracaw (1980) argue that the underwriters performing the information production role can reduce information asymmetry and increase the price investors are willing to pay. This implies that underwriters can play a part in achieving more accurate pricing. This notion is supported by the 'certification hypothesis' which suggests that the underwriters certify the offer price with their reputation capital (Booth & Smith, 1986). Based on this rationale, it can be argued that involving a reputable underwriter reduces mispricing by making the firm more credible. Further, the involvement of a reputable underwriter also implies that the underwriter is risking its reputation and would not associate itself with a poor quality firm (Fernando, Gatchev & Spindt, 2005).

Various studies have been conducted to examine the impact of issue certification on mispricing. Carter and Manaster (1990) see underwriter reputation as a measure of issue certification because reputable underwriters provide better certification and are associated with less mispricing. In contrast to this, Beatty and Welch (1996),

and Loughran and Ritter (2002), find that reputable underwriters are associated with more mispricing. They suggest that this is driven by the changing characteristics of the firms going public. Later studies support the finding that if the underwriter has a good reputation, this increases mispricing (e.g. Dolvin & Jordan, 2008; Gygax & Ong, 2011).

Issue certification is not only provided by underwriters but also by other players in the IPO process. Megginson and Weiss (1991) show that the involvement of a venture capitalist (VC) can also reduce investors' uncertainty about the value of a firm. The involvement of a venture capitalist provides investors a degree of comfort as they know that the VCs would have used their knowledge and resources to assess the firm, and would have performed extensive due diligence before becoming involved. Later studies by Chang, Gygax, Oon and Zhang (2008) and Engelen and van Essen (2010) confirm this finding.

2.2.1.4 The cascade theory

Welch (1992) argues that the IPO market is subject to information cascades. The term 'information cascade' refers to investor behaviour when investors rely on the buying behaviour of earlier investors and tend to overlook the information they themselves possess. When a potential investor observes that no one else is subscribing to the stock they may also not purchase it, despite having favourable information. To avoid this happening, an issuer may misprice the new issue to generate the interest of the first few buyers to subscribe. This behaviour creates a cascade effect and all subsequent investors are induced to purchase the stock, irrespective of the information they possess. This theory has different implications for the fixed price and book building methods of pricing IPOs. Under the fixed price method, because the price is pre-set by the issuer (and underwriter), issuers tend to misprice more, as initial investor behaviour triggers sequential demand and later investors will follow them. In the book building method the issuer (and underwriter) are less uncertain and have a better idea of what investors will be willing to pay for the IPO and so can price more correctly that leads to less mispricing. Therefore in the book building method cascades are less likely to be needed and developed.

2.2.1.5 The costly information acquisition theory

Benveniste and Spindt (1989) argue that underwriters tend to induce informed investors to reveal information about the firm valuation during the pre-selling process. The book building method is a mechanism used by underwriters to induce informed investors to reveal accurate information. This information is then used in the issue pricing. In order to encourage informed investors to reveal accurate and positive information, underwrites misprice the offer as a compensation. Furthermore, the issues where more favourable information is revealed have higher mispricing levels than the ones where less favourable information is revealed. Sherman (2000) shows that IPOs are mispriced as compensations for investors to evaluate issues. This rationale is more applicable in an environment where the book building method of pricing is prevalent. On the other hand, if the investors provide incorrect information, the issue may be priced higher than what market is willing to pay and this will lead to negative returns.

2.2.2 Institutional reasons

There are three institutional theories that explain IPO mispricing: litigation against risk, price stabilisation by underwriters and political interference. A relatively recent body of literature has emerged which uses macro-environment variables to capture the institutional factors affecting IPO mispricing (see Section 2.3). However, at the firm level, there is little empirical evidence available, primarily because of the lack of availability of the data that is required to empirically test these reasons, especially for examining price stabilisation activities carried out by underwriters and for studying political interference in the IPO process. Price stabilisation involves the underwriters carrying out trades to prevent the price from falling below a certain level. Price stabilisation activity can only be examined if the information on identity of the entity (or investors) carrying out the trade and the volume of trade are available. The price stabilisation activity is not widely researched, in some cases because laws in several countries do not allow price stabilisation activities, and in others because the data is not made available due to privacy protection. Likewise, it is generally difficult to know whether politicians are interfering with pricing of IPOs for their personal benefit.

2.2.2.1 Insurance against litigation

The idea that IPO mispricing provides a cover against litigation risk from investors who are disappointed with the performance of IPO shares goes back to Ibbotson (1975). This idea does not have a lot of empirical support (e.g. Drake & Vetsuypens, 1993; Hughes & Thakor, 1992; Keloharju, 1993), but it does have some economic relevance. Regulatory bodies impose strict policies regarding disclosure of new issues, which makes all signatories liable for any material omission in the prospectus. This exposes issuers and underwriters to the risk of litigation by shareholders on grounds of excluded or misstated information in the prospectus (Tinic, 1988).

Another important legal requirement under which issuing firms are bound is to disclose in the IPO prospectus any potential risk factors[5] that the issuers deem may affect the firm's operations. This motivates riskier firms to include more risk factors in the prospectus to avoid misrepresentation and reduce the litigation risk. However, the higher number of risk factors reported in the prospectus increases the issuer's risk profile and results in higher mispricing. Beatty and Welch (1996) and Gygax and Ong (2011) find that IPOs that report more risk factors in their prospectuses are mispriced by larger amounts.

2.2.2.2 Price stabilisation

Price stabilisation refers to artificially manipulating the demand and supply of IPO shares to manage share prices in the secondary market.[6] The function of price stabilisation is primarily performed by the financial institution acting as an underwriter, and/or in some cases, by their analysts who provide buy and sell recommendations. The practice of price stabilisation is legal in many countries such as the US, the UK, France, Germany, and the Netherlands. However, the empirical evidence on actual price support activities is limited to the US market and that information is also restricted by limitations on data availability (Ritter, 2003; Ruud, 1993).

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[5] This is mandated by Item 503 of Regulation S-K under the US Securities Act of 1933 which provides reporting guidelines for public companies in the US. Similar disclosure is mandated in Australia by Section 52 of the Trade Practices Act 1974.

[6] Our discussion on price stabilisation is limited to discussing the empirical evidence because price stabilisation is restricted in three out of the four sample markets (Australia, China and Malaysia) examined in this thesis and the unavailability of data for the US.

The evidence shows that underwriters follow new issues in the aftermarket by performing stabilisation and price support activities, which Ritter (2003) considers as legally permissible manipulation of stock prices in the aftermarket. In the US, most underwriters get an overallotment option of 15 per cent of the total shares offered. This overallotment option is fully exercised in about 66 per cent of the issues. The purpose of using the overallotment option is to cover short position in case of price decline in the initial period of the stock issue. Moreover, underwriters also make penalty bids[7] to penalise investors involved in stock flipping. This practice encourages underwriters to allocate issue to buy-and-hold investors and discourages investors who sell instantly after listing. It is commonly observed that underwriters sell up to 115 per cent of the IPO shares if low IPO demand in the aftermarket is predicted. Since a maximum 115 per cent of the number of shares outstanding can be issued, the underwriters use the overallotment option to cover the short position for the extra 15 per cent of the offer size (Aggarwal, 2000). According to Hanley, Kumar and Seguin (1993) engaging in price support activity decreases underwriters' holding risk in the aftermarket. Schultz and Zaman (1994) examine IPO aftermarkets and find that underwriters make inside bids for cold IPOs[8], and that they repurchase around 20 per cent of the stock available at the time of the IPO during the first three days of trading. They also report that for cold IPOs, the volume of sell bids is higher than the volume of buy bids for the first three trading days.

2.2.2.3 Political interference

The area that receives the least attention in empirical examinations of mispricing is political interference in the IPO process at the firm level. The proposition that IPO mispricing is caused by interference from political elites in the IPO process is mostly argumentative, indirect and observation-based. Jenkinson and Ljungqvist (2001) mention that regulatory constraints imposed on IPO pricing, such as the requirement that IPO pricing should follow prescribed procedure and must be between limits determined by a pre-set price-to-earnings ratio.

[7] "Penalty bids" refers to the practice in which underwriters penalise investors who quickly sell their stock (flip) in the aftermarket by taking their selling concessions (see Aggarwal, 2000).
[8] Cold IPOs are those issues which trade at or below the offer price (Schultz & Zaman, 1994).

Ibbotson and Ritter (1995) highlight some cases where IPO were allocated to gain favour with politicians. One of the highlighted cases involved the large and intentional underpricing of The Recruit Cosmos IPO in Japan, which then led the prime minister to resign. Most of the shares were allocated to politicians. When details were released many of the politicians involved had to resign. The scandal later led to crucial amendments to IPO regulations. During denationalising of British government services in 1979, the government, in order to appease voters, intentionally underpriced and allocated shares to a wide range of voters across the country. As a result the government raised $57 billion and budget surpluses emerged during the period 1979–1990. British denationalised IPOs had average initial returns of 41 per cent, which is higher than the average underpricing of normal issues (see Levis, 1993). This and other historical evidence suggests that most of the denationalised IPOs are usually more mispriced than new issues of other companies. Moreover, studies of the Chinese market also suggest IPO mispricing is a result of political interference and political favours. Tian (2011) sheds some light on this issue in an examination of IPO mispricing in China. The study states:

> First, the government frequently intervenes in the market. For instance, a policy commentary explicitly commented on the high price-earnings ratios of the stock market in People's Daily, the official newspaper of China's Communist Party, in 1996. This official commentary brought down the stock index 32% in only two weeks. The government also uses other methods to influence this market for its policy targets, including the IPO quota system to be illustrated in this paper. Second, rent-seeking activities appear rampant with corruptions in the primary market and insider trading is commonplace in the secondary market. Third, the market was somehow closed to most international investors. Without licenses, foreign investors are not allowed to invest in the major Chinese stock market, which is called the A-share market. In fact, the qualified financial institutional investors program was not implemented until the end of 2002, and allows only very large investors, like Morgan Stanley, to invest in China's A-share market with limited capital under the authorization of the CSRC (p. 81).

2.2.3 Regulatory constraints and ownership dispersion

Mispricing of IPOs may be caused by constraints put on IPO pricing by regulators. This notion has little relevance in markets (such as the US and Australia) where

IPOs are priced without regulatory restrictions. In countries (such as China at one time) where regulations require that IPOs be priced based on book value, dividend yield, price-to-earning or market-to-book ratios, mispricing is found to be high (e.g. Guo & Brooks, 2008; Jelic et al., 2001; Jenkinson & Ljungqvist, 2001).

Similarly, in countries where shareholders' rights are strong, issuers prefer dispersed ownership to reduce outside control. To achieve this, issuing firms deliberately misprice the issue to generate excess demand for their shares among a large body of small investors. This dispersed ownership increases the market liquidity of the issue and keeps management safe from outside influence (Booth & Chua, 1996). Brennan and Franks (1997) suggest that firms intentionally misprice issues to dilute ownership concentrations. Some managers, at disadvantage of shareholders, may misprice an issue for control reasons. Some managers, to benefit the shareholders, may overprice the issue.

2.2.4 'Hot issues' market

Ljungqvist (2007) reports that cycles exist in the initial returns of US IPOs. There are periods when IPOs are on average underpriced; then there are periods when IPOs are on average overpriced and periods when the IPOs are significantly discounted. The period of significantly high levels of mispricing is referred to as 'hot issues' market, was initially identified by Ibbotson and Jaffe (1975) and later by Ritter (1984). They show that the mispricing of IPOs is greater in buoyant markets.[9] The evidence for the existence of hot issues markets is not restricted to the US and is also observed in other markets. For example, Davis and Yeomans (1976) in their study of the UK market find that high market returns cause significant rises in the valuation of the new issued shares. McGuinness (1992) reports similar findings for the Hong Kong market. According to McGuinness IPOs are more mispriced during bull markets than bear markets. Similar findings are reported by Ljungqvist (1997) for Germany where IPO mispricing is positively correlated with stock market returns preceding the IPO date, and with favourable macroeconomic conditions measured by Business Climate Index.[10] This suggests

[9] A buoyant market is referred to as a period when the market index indicates high returns.

[10] Developed by Ifo Institutive for Economic Research, the Business Climate Index is a leading indicator for macroeconomic activity in Germany. This index is aggregation of surveyed data, queried on firms, measuring business climate, current business situation and business outlook.

that IPOs will be more mispriced when firms go public during periods of market exuberance when investors are more likely to overvalue IPOs.

2.3 Mispricing and country-level characteristics

A relatively recent body of literature has emerged that suggests that IPO mispricing is also caused by country-level characteristics, such as institutional quality and economic condition. Institutional quality is determined by the formation, enforcement and compliance of laws within an economic structure (van Essen, Van Oosterhout & Heugens, 2013). Studies by La Porta et al. (1997), La Porta, Lopez-de-Silanes, Shleifer and Vishny (1998), La Porta, Lopez-de-Silanes, Shleifer and Vishny (2000) and Djankov, La Porta, Lopez-de-Silanes and Shleifer (2008) suggest that differences in the institutional frameworks of countries explain the differences between the financial markets and decision-making processes of companies and investors. Similarly, the economy has a huge impact on how financial institutions perform. Robinson (1952) argues that economic growth results in higher demand for financial services, which leads to financial development. As an economy grows, its gives rise to economic activities which tend to become more specialised. Specialised economic activity requires the formation of markets that provide a trading structure which facilitates easy access to capital for companies and provides investment opportunities for investors. In the following subsection, we examine the impacts of institutional quality and economic conditions on secondary markets and IPO mispricing.

2.3.1 Institutional quality

La Porta et al. (1997) demonstrate that the legal framework of a country impacts on the size and operations of its capital markets. Having a developed institutional environment that has better regulations and implementation of laws makes it easier for firms raise capital through IPOs (Boulton et al., 2010). At the same time a strong institutional environment also protects outside investors against any risk of expropriation by majority shareholders or management, and puts control of the initial owners at risk. However, in an environment where the risk of the expropriation is less, there is less risk associated with subscribing to those IPOs, which in turn leads to lower levels of mispricing and vice versa. On the other hand, if the initial owners have cheap and effective strategies which enable them to retain control over the firm, and this control would be lost if the owners create demand by

selling IPO at a lower price, the incentive to misprice will be minimal.[11] In such cases, the issuing firms are more incentivised to overprice. Peng and Jiang (2010) also show that, in countries with stronger institutions, the benefits of having concentrated ownership may outweigh the costs, and the owners would not misprice to maintain control over the firm.

As discussed in the previous sections, IPO mispricing is largely impacted by firm-level uncertainties about firm value. A growing body of literature indicates that not only firm-level uncertainties, but also uncertainties that are present in the institutional frameworks of countries, have a significant impact on IPO mispricing (Autore et al., 2014; Engelen & van Essen, 2010). A country with poor rule of law and inadequate legal protection for investors has greater uncertainty about its post-issue operations and strategic decisions. In such an environment, investors who subscribe to IPO shares will require more money left on the table to compensate for the risk they take by investing in those IPOs. Thus, the higher the level of uncertainty about the firm, the higher the mispricing of the IPOs is likely to be. The uncertainty caused by country-level factors adds to the uncertainty caused by firm-level factors. Firms with lower quality underwriters, for instance, are mispriced to a greater extent due to higher firm-level ex-ante uncertainty about firm value. However, a firm that has a lower quality underwriter and goes public in an environment with poor regulations and rule of law is likely to be more mispriced than one with a lower quality underwriter that goes public in an environment with better regulations and rule of law.

Another way a country's institutional quality affects ex-ante uncertainty is the future distribution of firm value among its corporate stakeholders. In a country that has poor regulations and low government effectiveness, controlling shareholders will have more opportunities to transfer assets or firm profits at the expense of the minority shareholders. Thus, a higher probability of expropriation of profits by controlling shareholders is likely to increase ex-ante uncertainty, resulting in higher IPO mispricing. Cheung, Ouyang and Weiqiang (2009) show that this expropriation

[11] This is based on the findings of Brennan and Franks (1997) that IPO firms misprice to create excess demand causing oversubscription of the IPO shares, then by rationing they create dispersed ownership base so that the initial owners retain control on the firm. Brau and Fawcett (2006) and Hopp and Dreher (2013) also show similar results.

of wealth takes place in the form of investor dilution, asset stripping and transfer pricing. Therefore, investors in a country with a poor institutional framework will have more uncertainty about their returns on investment (Shleifer & Vishny, 1997). Therefore, issuers in these countries are likely to have to leave money on the table to attract investors to subscribe to the IPO.

Corruption is also argued to be a key factor in IPO mispricing (Jenkinson & Ljungqvist, 2001; Tian, 2011). Corruption is found to be associated with reductions in investment by a firm which as a result ceases to grow (Ades & Tella, 1997). Firms in this position also suffer from reduced productivity and less effective management (Athanasouli & Goujard, 2015). They also tend to be less efficient (Dal Bó & Rossi, 2007), and cause significant harm to growth of private firms (Nguyen & Van Dijk, 2012). Corruption can also divert a company away from its regular efficient operations (Gounopoulos & Huang, 2017). All of these factors may contribute to increased uncertainty about the firm, resulting in higher mispricing. This suggests that higher levels of corruption (indicating lower levels of institutional quality) would result in greater mispricing of IPOs.

Being located in a country with high-quality institutions has both positive and negative impacts on mispricing. On one hand, strong institutions make it easy for firms to raise capital; on the other hand, strong institutions also strengthen positions of minority investors and reduce the entrepreneurs' control over their firms (Djankov et al., 2008; Boulton et al., 2010). Similarly, strong regulations and good law enforcement make corporate disclosure more transparent, and also expose firms to the risk of losing value in the event of loss making. Therefore, issuers in countries with strong institutions who want to retain control over their firms have an incentive to price their IPOs lower, as setting a lower price will result in dispersed ownership and less monitoring by minority shareholders (Boulton et al., 2010). On the other hand, Engelen and van Essen (2010) argue that strong institutions reduce uncertainty, as investors are more confident that they are protected by law against any expropriation by the controlling shareholders, and thus firms in these situations require less mispricing.

2.3.2 Economy

A growing economy gives rise to demand by firms for raising capital. Thangavelu, Jiunn, and others (2004) use change in GDP per capita as a measure of economic growth, and find that a growing economy improves the efficiency of financial markets and increases investment opportunities in stock markets. Levine and Zervos (1998) find a positive correlation between stock market trading and GDP growth. This suggests that a growing economy increases demand for new capital and is likely to give rise to IPO activity. Similarly, Ritter (1984) finds that IPOs are more mispriced at times when there are more firms going public. This is further supported by Hopp and Dreher (2013) who find a positive correlation between IPO mispricing and GDP growth. On the other hand, the size of the economy, measured as GDP per capita, is meant to reduce ex-ante uncertainty and subsequent mispricing about the firms, since large economies are associated with a less risky business environment (Engelen & van Essen, 2010). Boulton et al. (2017) report an indirect relationship between the size of the economy (measured as the log of GDP per capita) and IPO mispricing. Their study focuses on examining the impact of country-level accounting conservatism[12] on IPO mispricing. They show that larger economies have higher levels of conservatism and that higher levels of conservatism lead to less mispricing. This supports the view that IPOs in larger economies are likely to be less mispriced.

2.4 Summary

The literature, which spans over four decades, suggests that IPOs are consistently found to be mispriced across time and markets. While IPOs are on average underpriced, a significant number of them are overpriced. Theories that explain the mispricing of IPOs by looking at firm-level factors suggest that the mispricing is caused by: (a) information asymmetry between IPO participants, (b) information signalled by the issuers to mitigate the information asymmetry, (c) the role and impact that a financial institution acting as an underwriter has on mispricing, (d) ownership dispersion and (e) hot issues markets. In addition, a recent body of

[12] Boulton et al. (2017) define conservatism as accounting practices through net book value of assets is systematically understated relative to market values.

literature suggests that in addition, the strength of a country's institutional quality and economy also affects the mispricing of IPOs.

Our review of the literature identifies that studies examining IPO mispricing show that (a) the literature on IPO mispricing has focused mainly on explaining the underpricing phenomenon, and that little attention has been paid to explaining the overpricing of IPOs; (b) country-level studies are not very common in the domain of IPO mispricing; and (c) the literature on the relationship between IPO mispricing and the state of a country's economy is extremely scarce.

The next chapter discusses the research design by putting forward (a) the variables that are used in the subsequent empirical chapters, (b) the sources from where the data was obtained and (d) the methods used for analysis.

Chapter 3: Variables, Data and Method

3.1 Introduction

Building on the previous chapter, in Section 3.2 we discuss the variables used to examine the mispricing in the four sample countries – the United States (US), Australia, China and Malaysia. Section 3.3 outlines the data sources for each country, which is followed by a discussion of the methods that are used to examine the IPO mispricing, in Section 3.4.

3.2 Variables

3.2.1 Measuring first day returns

IPO mispricing is measured as the first day IPO returns expressed as the percentage difference between the first day closing price of the IPO and the IPO offer price as shown in Equation (3.1).

$$RR_{i,t} = \frac{P_t - P_0}{P_0} \qquad (3.1)$$

where

$RR_{i,t}$ = first day raw return of stock *'i'*

P_t = first day closing price of stock *'i'*

P_0 = offer price of stock *'i'*.

3.2.2 Firm-level independent variables

The discussion in the previous chapter has highlighted several firm-specific variables that have been found to explain mispricing in markets. We use a combination of these factors to examine their impacts on mispricing of IPOs across the four markets. Appendix B describes all the variables used in the thesis, describes the symbols to represent them, and identifies the data sources used to assess their impacts.

3.2.2.1 Company characteristics

The extant information about the company going public has an effect on mispricing. More information is associated with less mispricing. In cases where less

information is available, the issuers have to provide incentives (by lowering the share price) to the investors to encourage them to purchase the IPO shares. The size of the firm, measured by the value of pre-listing assets ($logAssets_i$, measured as natural log of one plus the total assets stated in the balance sheet), is a good indication of issuer quality. Larger firms are usually associated with less information asymmetry as more is known about them and thus require less mispricing (Beatty & Welch, 1996). Similarly, the age ($logAge_i$, measured as natural log of one plus the age of the firm in years at the time of going public) of the issuer is used as a measure of the issuer's quality. The older the issuer, the greater the availability of historical information on pre-listing performance to help investors arrive at a more accurate valuation of the equity, and thus reduce the ex-ante uncertainty and mispricing (Loughran & Ritter, 2002).

Clarkson, Dontoh, Richardson and Sefcik (1992) argue that issuers tend to signal private information to the market by providing *earnings forecast* (EPS_i) in the prospectus. Issuers seek to distinguish themselves by providing earnings forecasts as good news to investors (Lev & Penman, 1990), which reduces information asymmetry and requires less mispricing.

Leland and Pyle (1977) suggest that the owners of firms going public have superior information about the quality of the firm's operations, and thus the proportion of their own funds invested in the firm are likely to signal their long-term commitment to the firm as well as the issuer's expectations about the future profitability of the firm. Therefore, a higher proportion of shares retained ($RetOwn_i$, calculated as one minus the number of shares issued divided by the total number of shares outstanding) by the owners is likely to induce higher first day returns. Welch (1989) shows that the issuers who highly underprice their IPOs are likely to retain a larger portion of the equity and will sell it in later offerings to garner higher proceeds. On the other hand, since the issuers know more about the prospects of their firms they may increase the issue price to profit from the expectations of a profitable future, which is likely to result in lower levels of mispricing.

3.2.2.2 Offer characteristics

The capital to be raised in the IPO ($logOS_i$), measured by natural logarithm of the product of final offer price and the number of shares offered, indicates the size of

the issue and the magnitude of the issuer's intentions regarding future expansion. The total value of money to be raised from the IPO is a proxy for future expansion and firm quality. Plans for significant future expansion reduce ex-ante uncertainty and the resultant mispricing (Beatty & Ritter, 1986; Gygax & Ong, 2011). This finding is confirmed by Corhay, Teo and Tourani-Rad (2002), Dolvin (2005), Chang et al. (2008) and Tian (2011).

The two most commonly used methods used by firms to go public (IM_i) are fixed price offers and book building. Under fixed price offers, the issuers offer the IPO at a pre-determined fixed price for investors to submit their subscription offers. In this case, the issuers have less information about the demand for the IPO which leads to higher mispricing. On the other hand, the book building method involves the underwriters engaging with potential investors to assess their interest as an indication of the demand and the value that the investors place on the IPO. In the context of Rock's (1986) winner's curse model, Benveniste and Wilhelm (1990) argue that the book building method of going public, as it is based on better information, reduces information asymmetry, leading to lower levels of mispricing.

The price of the issue, *offer price* ($InvOP_{i,,}$ one divided by the final offer price per share), has been found to be a major determinant of magnitude and direction of the mispricing. Gygax and Ong (2011) find that a lower offer price leads to less mispricing. This is because firms that set a lower offer price experience an increase in relative transaction costs for investors and higher post-IPO trading commissions which attract more scrutiny by analysts who are likely to closely follow such stocks. Brennan and Hughes (1991) suggest that issuers use a lower offer price as a signal of quality and thus reduce uncertainty by attracting analysts' coverage. On the other hand, Chang et al. (2008) find that a lower offer price increases mispricing. Beatty and Welch (1996) argue that if a disproportionate percentage of riskier firms set lower offer prices, then investors are likely to revise their risk perceptions about the firm, leading to a greater mispricing of IPO shares.

3.2.2.3 Issue certification

Brau and Fawcett (2006) find that issuers attempt to signal the quality of their offering by appointing a reputable financial institution as the underwriter (UMS_i). The involvement of a reputable underwriter gives investors an assurance that the

underwriter will carry out thorough due diligence or otherwise put their own reputation at risk (Booth & Smith, 1986; Carter, Dark & Singh, 1998). Therefore, firms that are underwritten by reputable underwriters are likely to experience lower levels of mispricing (Dimovski & Brooks, 2004; Guo & Brooks, 2008).

Similarly, the involvement of a venture capitalist (VC_i) also reduces investors' uncertainty about the value of the firm. The rationale is that this involvement provides investors with a degree of comfort, since the investors know the VCs will have used their knowledge and resources to assess the firm by performing extensive due diligence before getting involved. Megginson and Weiss (1991) argue that IPOs that involve venture capitalists as early investors are less likely to be mispriced. Later studies by Loughran and Ritter (2004) and Cao, Tang, and Yuan (2013) confirm these findings.

3.2.2.4 Prospectus risk disclosure

Issuers are required to disclose in the prospectus the risk factors (RF_i) associated with the new issue and the steps undertaken to minimise these risks. While riskier firms are expected to yield higher returns, the provision of the steps taken to minimise those risks that may potentially affect the IPOs would reduce the *ex-ante* uncertainty associated with the IPOs and thus the resulting mispricing. Hence, the inclusion of the risk factors in the prospectus shifts the risk to investors, reducing the marketability of the issue and increasing the uncertainty and the resulting mispricing (Beatty & Welch, 1996).

3.2.2.5 Market sentiment

Ritter (1984) suggests that more firms go public during periods of euphoric market sentiment ($MP30_i$), and that IPO mispricing is higher in periods when markets are performing well. Autore et al. (2014) suggests that market index returns are a good measure of market sentiment and high returns will increase the initial IPO returns. Further, studies show that the level of mispricing is influenced by the timing of the issue (Ibbotson, 1975), which is controlled by adding a set of year dummies to the empirical model.

Similarly, Paudyal et al. (1998) show that market volatility also increases mispricing of IPOs. For this we use *RelVol* as a measure for realised volatility, calculated in Equation (3.2).

$$RelVol = \sqrt{\frac{252 * \sum_{i=0}^{N-1} \left(ln\left(\frac{PX_{t-i}}{PX_{t-i-1}}\right)\right)^2}{N}} \quad (3.2)$$

where:

PX_i = price return index level of the market index on day t.

N = Number of trading days in lookback period

3.2.2.6 Institutional characteristics

The *time lag* between the IPO date and the listing date is found to be positively associated with mispricing (Mok & Hui, 1998; Yu & Tse, 2006). Different explanations have been offered for this behaviour. For example, in instances where the offer price is set many days before the IPO sale closes, information about the demand for the IPO may be leaked. This information is an important factor in determining the price at which the IPO will be traded in the aftermarket. Such a leak of information would drive oversubscription of the IPO shares and increase the initial IPO returns. On the other hand, if the investors consider the issue is priced too high and the IPO is likely to fail, the issuers are led to misprice the IPOs and leave money on the table to avoid IPO failure (Chowdhry & Sherman, 1996). In contrast, How, Izan, and Monroe (1995) argue that the length of the time lag between the IPO days and the listing date is a good indication of informed demand for the IPO. They suggest that issues that are sold quickly have more informed demand and are more mispriced, whereas issues that take time to sell are less mispriced. The incidence of long delays between the IPO date and the listing date are more prevalent in China where time lag is found to be significantly and positively related to the mispricing (Chen, Firth & Kim, 2004; Tian, 2011).

The stock exchange where the IPO is listed is also an important driver of IPO mispricing. Loderer, Sheehan and Kadlec (1991) and Corwin (2003) report significant differences in the first day IPO returns of issues made on different stock exchanges. Our sample consists of the IPOs from four countries, that is, US,

Australia, China and Malaysia. China and the US, each country has two stock exchanges. Malaysia has two boards that operate within Bursa Malaysia (formerly known as the Kuala Lumpur Stock Exchange). Hence, we control for the exchange of listing (*Exchange$_i$)* or the listing board (*Board$_i$*) using an appropriate dummy variable in each study. There are two stock exchanges in mainland China (i.e. the Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange (SZSE)), where domestic A-shares are traded. Chen et al. (2004) show that the IPOs listed in the Shanghai Stock Exchange are more mispriced than those in the Shenzhen Stock Exchange. Similarly, there are two main stock exchanges in the US (i.e. the New York Stock Exchange (NYSE) and the National Association of Securities Dealers Automated Quotations (NASDAQ)). The companies that are listed in the NASDAQ are mostly technology and growth companies which are likely to be more mispriced. The literature has found the NYSE is less mispriced than the NASDAQ (Lowry, Officer & Schwert, 2010). In Malaysia, issuers can choose between boards (i.e. the Main Market and the ACE Market for listing). However, the issuers need to meet the Bursa Malaysia Listing Requirements (BMLR) in order to get a listing. The former has stricter scrutiny than the latter.

3.2.3 Country-level independent variables

3.2.3.1 Institutional quality

The first day IPO returns vary across countries (Loughran et al., 1994), which a relatively recent body of literature attributes to the quality of the country's institutions and the state of the economy in which an IPO is listed. Therefore, to examine the impact of country-level factors on IPO mispricing, we use the proxies of institutional quality developed Kaufmann, Kraay and Zoido-Lobatón (1999) and updated by Kaufmann et al. (2015). These proxies capture the institutions and traditions within a country that drive the exercise of authority. This includes policy formulation and implementation, institutions governing economic and social interactions, and selection of government. The proxies are measured by a set of six variables: control of corruption, government effectiveness, political stability and the absence of violence, regulation quality, voice and accountability, and rule of law. According to Engelen and van Essen (2010), the higher the institutional quality, the lower the ex-ante uncertainty and mispricing.

3.2.3.2 Economic growth and size

La Porta et al. (1997) and Djankov et al. (2008) suggest that the rate of growth and size of an economy affect a firm's ability to raise capital, as firms in smaller or weaker economies are likely to find it hard to raise funds through IPOs, and thus fewer companies will go public. We choose two economic variables to measure economic strength: economic growth (*GDP growth*) and economic size (*GDP per capita*). La Porta et al. (1997) argue that economic growth rate affects valuations and IPO activity. A growing economy increases the demand for domestic equity and thus more firms approach equity markets to raise capital. Meanwhile, investors are willing to pay higher prices for the shares. Domowitz, Glen and Madhavan (2001) find a positive correlation between GDP growth rate and first day IPO returns. Engelen and van Essen (2010) argue that a country with a large economy (measured as GDP per capita) will have lower ex-ante uncertainty and thus will require lower mispricing.

3.3 Data

This thesis examines IPO mispricing in four countries over a sample period of 1995–2013. Multiple sources are used to collect the data for each market. Details of sampling are listed below.

The United States: The names, listing dates and data on independent variables of 4014 US IPOs were identified using the SDC Platinum New Issues Database. The data on missing observations was filled using prospectuses sourced from Thomson One Banker, stock exchange websites and Jay Ritter database.[13] The daily trading prices of stocks, the NYSE Composite Index and the NASDAQ Composite Index, which are used as benchmarks for market performance and for the calculation of realised volatility, are collected from Thomson Reuters Datastream. The construction of the final sample for analysis involved certain adjustments. The firms with missing data, missing identifiers, unavailable historical prices, unit trusts, stapled securities[14], issues without a public offer component and ADRs were

[13] Prof. Ritter's IPO data is publicly available at https://site.warrington.ufl.edu/ritter/ipo-data/

[14] A stapled security is a type of financial instrument. It consists of two or more securities that are contractually bound to form a single sale-able unit; they cannot be bought or sold separately.

excluded.[15] We ended up with 2458 IPOs for the final sample. The data is used in Chapters 4 and 8.

Australia: The data were obtained from multiple sources. The names and the listing dates of 1361 Australian IPOs were identified using the Morningstar Global Database. The offer prices of the IPOs and all the independent variables except for market performance and realised volatility were obtained from the IPOs' prospectuses, available on the Thomson One Banker and Australian Securities Exchange (ASX) websites. The daily trading prices of the stocks and the ASX All Ordinaries Index, which was used as a benchmark for market performance and for the calculation of realised volatility, were collected from Thomson Reuters Datastream. The construction of the final sample for analysis involved certain adjustments. Firms with unavailable prospectuses, unavailable historical prices, unit trusts, stapled securities, issues without a public offer component and CHESS Depository Interests (CDIs) were excluded. The final sample consisted of 1095 IPOs. The data is used in Chapters 5 and 8.

China: The names and listing dates of 2235 Chinese A-share IPOs, listed on the Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange (SZSE), were identified using the Morningstar Global Database. The data for all the independent variables except for market performance and realised volatility were collected from in the IPO prospectuses available on the Thomson One Banker and the SSE and the SZSE websites. The daily trading prices of stocks and the composite indices of the market where the stocks are listed, which are used as benchmarks for market performance and for the calculation of realised volatility, were collected from Thomson Reuters Datastream. The construction of the final sample excluded firms with unavailable prospectuses, unavailable historical prices, close-end funds and issues without a public offer component. We ended up with a final sample of 2199 IPOs. The data is used in Chapters 6 and 8.

[15] Exclusions of unit trusts, stapled securities, issues without public offer component and CDIs from the US data as well from the other countries data are carried out following Krigman et al. (1999) and Ritter and Welch (2002). These types of offerings are not considered as an IPO and would not affect the results.

Malaysia: The names and listing dates of 459 Malaysian IPOs issued during our sample period were obtained from Bursa Malaysia. The offer prices of the IPOs and all the independent variables except for market performance and realised volatility were obtained from the IPOs' prospectuses, available via the Thomson One Banker and Bursa Malaysia websites. The daily adjusted trading prices of the stocks and the FTSE Bursa Malaysia Index, which was used as a benchmark for market performance and for the calculation of realised volatility, were collected from Thomson Reuters Datastream. The construction of the final sample excluded firms with unavailable prospectuses and unavailable historical prices, unit trusts, stapled securities and issues without a public offer component. We ended up with a final sample of 419 IPOs. The data is used in Chapters 7 and 8.

Country-level data: For the country-level variables, Worldwide Governance Indicators developed by Kaufmann et al. (2015) were obtained from World Bank's governance indicators. The data on GDP growth and GDP per capita were sourced from World Development Indicators available from the World Bank's data catalogue. The time series exchange rates, which were used to convert offer price, total assets, offer size and EPS values from home currency to US dollars, were obtained from Thomson Reuters Datastream. The data was used in Chapter 8.

3.4 Method

This section describes the empirical methods used to analyse the effects that the independent variables have on the IPO mispricing. First, we describe the empirical model used to investigate the relationship between the first day IPOs returns, followed by the estimation techniques.

3.4.1 Empirical model

Based on the above discussion, our base model is given in Equation (3.3).

$$logRR_{i,t} = \alpha + \sum_{j=1}^{J} \beta_j X_{it}^{j} + \sum_{k=1}^{K} \beta_k X_{it}^{k} + \sum_{l=1}^{L} \beta_l X_{it}^{l} + \sum_{m=1}^{M} \beta_m X_{it}^{m} + \varepsilon_i \quad (3.3)$$

where the dependent variable is the natural log of one plus the first day returns calculated in Equation (3.1); X_{it}^{j} refers to a set of firm-level explanatory variables;

X_{it}^{k} refers to a set of country-level variables; X_{it}^{l} is a set of country dummies to control for country effects and X_{it}^{m} is a set of year dummies introduced to control for time effects. Equation (3.7) provides a base model to examine the determinants of the IPO mispricing. The selected countries differ in their institutional and regulatory characteristics, and thus we have to slightly modify the individual models for each country in order to reflect the institutional characteristics in that country. To capture these changes, we present separate empirical models to examine the determinants of mispricing in each country study by dropping or adding independent variable(s) where necessary.

3.4.2 Estimation techniques

In order to examine IPO mispricing in the four countries, we use the regression model in Equation (3.3). Regression analysis studies changes in the dependent variable as one or more independent variable changes. If we have a dependent variable y and a set of independent variables x, we seek to understand changes in *y* – that is, E(*y* | *x*), conditioned on changes of *x*.

A common way of examining the impact a set of independent variables has on an independent variable is ordinary least squares (OLS) regression. The functional form of which is given in Equation (3.4).

$$y_i = x_i.\beta_i + u_i \qquad (3.4)$$

where y_i is the dependent variable. x_i represent a set of independent variables to be regressed against y_i, β_i is the unknown coefficient of the independent variable to be estimated, and u_i is the error term. The subscript *i* (*i* = 1, 2 … *N*) denotes the *i*th IPO firm. The OLS regression estimates are obtained by minimising the sum of squared errors where the focus is on the mean of the response variable given the changes in the explanatory variables. This minimising technique is obtained by Equation (3.5).

$$min \sum(u_i)^2 = \sum_i^n (y_i - x_i\beta_i)^2 \qquad (3.5)$$

The coefficient, β_i, of Equation (3.4) would only provide an interpretation as to the extent and direction of the effect x_i would have on the mispricing. Similarly, Equation (3.5) shows that the error term is averaged by equal weights where $x_i\beta_i$

gives the conditional mean. This shows that the estimates obtained from the OLS method only gauge the accurate mean effect that the independent variables have on the dependent variable when the latter follows a normal distribution. Therefore, the OLS estimates may not capture the true relationship between the dependent and independent variables when the former's distribution is not normal. And focusing on the central region of the sample distribution would not differentiate between the effects of the independent variables on the IPOs that have negative, zero and positive first day returns. Since first day IPO return distributions are found to be not normal in the literature (e.g. Michaely & Shaw, 1994; Dimovski & Brooks, 2004; Wang, 2005; Dolvin & Jordan, 2008), and this is also the case with our sample IPOs (see Chapters 4–8), using the OLS method might provide poor estimates.

In cases when distribution of first day returns are found to be right skewed, the quantile regression (QR) approach developed by Koenker and Bassett (1978) is a more suitable method for examining first day returns (Buchinsky, 1998; Autore & Peterson, 2009; Lee et al., 2010; Lee & Kuo, 2010). The QR approach is an estimation method which allows us to examine the relationship between y_i and x_i for all the areas of the distribution y_i. These areas of the distribution are referred to as quantiles. The QR approach provides a good alternative which mitigates the effect of the non-normality of the data and to capture the relationship between the dependent and independent variables at varying levels of the sample distribution, including the tail regions. The QR approach allows us to examine the latent characteristics of the distribution of the IPO mispricing which ranges from negative to positive. By doing so the QR addresses the issue of distributional asymmetry in the estimation process.

The functional form of the quantile regression model is expressed in Equation (3.6) for the *qth* quantile. The value of *q* ranges from zero to one.

$$y_i = x_i\beta^{(q)} + u_i^{(q)} \qquad (3.6)$$

where y_i is dependent variable. x_i represents a set of independent variables to be regressed against y_i, $\beta^{(q)}$ is an unknown coefficient of the independent variables to be estimated associated with the *q*th quantile, and $u_i^{(q)}$ is the error term associated

with *q*th quantile. The regression estimates of $\beta^{(q)}$ associated with the *q*th quantile are obtained as follows:

$$\min\Big(\sum_{u_i^{(q)}>0} q \times \left|u_i^{(q)}\right| + \sum_{u_i^{(q)}<0} (1-q) \times \left|u_i^{(q)}\right|\Big)$$

$$= \min\Big(\sum_{y_i>x_i\beta^{(q)}} q \times \left|y_i - x_i\beta^{(q)}\right| + \sum_{y_i<x_i\beta^{(q)}} (1-q) \times \left|y_i - x_i\beta^{(q)}\right|\Big) \qquad (3.7)$$

By changing the value of q from 0 to 1, Equation (3.7) produces $\beta^{(q)}$ for the independent variables corresponding to the chosen quantile of the dependent variable. In this way, the quantile regression examines the whole distribution of the first day returns conditional on the independent variables. The comparison between Equations (3.5) and (3.7) reveals that in Equation (3.5) the sum of errors is minimised using equal weight which comes from a symmetric distribution, whereas Equation (3.7) minimises the absolute value of all the errors with unequal weights. The sum of the absolute values of all the errors is divided into two parts, the first part is assigned the weight q and the second part $(1 - q)$. The comparison between the $\beta^{(q)}$ of different *q*s could reveal potential differences in the behaviour of the first day returns across the sample distribution. This allows us to compare the impacts that the independent variables have on the different categories of the first day returns (e.g. overpriced vs. underpriced IPOs), which is not possible if we use OLS to explain the relationship between the dependent and independent variables across the sample.

The above discussion highlights the benefits of using the QR method over the OLS method. First, the use of QR allows us to overcome the issue of non-normality which is a key assumption for the OLS method. Second, the OLS, which focuses on the mean of the sample distribution, only provides a unique set of coefficients to ascertain the magnitude and direction of the relationship between the dependent and independent variables. The QR, on the other hand, produces multiple sets of coefficients corresponding to the selected quantiles across the whole distribution of the first day returns. By doing so, the QR method allows us to examine the whole sample distribution, drawing upon the potentially varying relationship between the

dependent and independent variables. That is, we can examine the impact of the independent variables on the overpriced, fairly priced and the underpriced IPOs.

3.5 Summary

Building on the literature review provided in Chapter 2, this chapter provides a discussion of the variables that are used in the examination of IPO mispricing across the four markets. Several variables are proposed to capture multiple factors that affect IPO pricing behaviour: company characteristics, offering characteristics, issue certification, risk disclosure, market sentiment, institutional factors, country-level institutional quality and economic size and growth.

Multiple sources are used to collect data such as the Morning Star Global Database, Thomson Reuters Datastream, Thomson One Banker, SDC Platinum, the ASX website, the Bursa Malaysia website, Jay Ritter's IPO database and the World Bank's data catalogue.

The thesis uses two types of regression models to examine IPO mispricing – the OLS and QR approaches. The OLS approach focuses on the average impact that the independent variables have on mispricing (which is usually positive). In this approach, the latent characteristics of the mispricing distribution, given that it does not follow a normal distribution, remains unexamined. Therefore, to examine the non-unique effects that the independent variables have on the various levels of mispricing due to asymmetric returns distribution, we employ the quantile regression (QR) approach. The QR approach enables us to identify the impacts of the factors on IPOs that fall within a particular level of mispricing. The QR method provides us with the following advantages over the OLS method. First, the QR approach is a robust method which deals with potential heterogeneity in the distribution, as is the case with our sample. Second, we are able to compare the results derived from the median QR with those derived from the traditional OLS to enrich the literature in terms of the situation of skewed distribution. Third, the QR method also enables us to examine different segments of the distribution of first day returns, including tail regions. By doing this we are able to compare the impacts of the explanatory factors on different levels of misprcing – that is, overpriced, fairly priced and underpriced IPOs.

Chapter 4: Mispricing in the United States

4.1 Introduction

This is the first of the five empirical chapters that examine the mispricing of IPOs in several markets – in this chapter, the United States (US) market. The US IPO market is considered to be the most thoroughly researched markets. This is reflected by the amount of literature that is produced on theoretical and empirical examinations of US IPOs. It is one of the most developed markets according to the MSCI Market classification and is usually referred to as a benchmark market for comparison with the other IPO markets around the world (e.g. Hamao et al., 2000; Ljungqvist et al., 2003; Gygax & Ong, 2011). The reasons the US IPOs market is used as a benchmark are: the US being the largest economy in the world having the most IPOs, its regulatory and institutional framework in which book building is the dominant method of pricing the IPOs (79.7% of the sample), its less stringent listing regulations, its shorter lock-up periods, its pre-issue marketing and the fact that underwriters have permission to carry out after-market activities.[16] Therefore, we take the US as our starting point for examining IPO mispricing.

Using a sample of 2458 IPOs listed in the New York Stock Exchange (NYSE) and the National Association of Securities Dealers Automated Quotations (NASDAQ) during the period from 1995 to 2013, we find mean mispricing of 34.90% and median mispricing of 2.4%, with 35.5% of IPOs having less than zero per cent returns (i.e. they are overpriced) and only 18.63% of the IPOs having returns above the average returns. The distribution of these returns is skewed to the right, with a skewness measure of 5.31, indicating that the return distribution is not normal.[17]

Previous studies concentrated on explaining the average mispricing (i.e. underpricing). Whereas, we show that underpricing is driven by a relatively small number of IPOs and that the distribution of the first day returns consists of a whole spectrum of mispricing ranging from significantly overpriced to significantly

[16] Aftermarket activities are briefly discussed in Section 2.2.2.2. The impact of these activities is examined by Ruud (1993), Hanley et al. (1993), Schultz and Zaman (1994) and Aggarwal (2000). Due to a lack of the sensitive data required to study these activities, we exclude them from the scope of our study.

[17] We conducted the Shapiro-Wilk test for normality and Breusch-Pagan-Cook-Weisberg tests for heteroskedasticity and confirmed that the first day returns were not normally distributed.

underpriced IPOs. To explain this wide divergence of mispricing we divided the mispricing distribution into various levels based on the magnitude and direction of the mispricing. The levels of mispricing for the US IPOs are: highly overpriced, overpriced, fairly priced, underpriced, highly underpriced and extremely underpriced.[18] The characteristics of the IPOs within each level of mispricing suggest that the IPOs of the firms that are young in age, large in size, have a venture capitalist and/or underwriter backing and are listed in the NASDAQ tend to be underpriced. These IPOs also tend to go public during periods of positive market performance and high market volatility. On the other hand, overpriced IPOs tend to be older, and have higher earnings forecasts, higher offer prices and less reputable underwriters.

4.2 Studies in the US

In the US, the empirical evidence of mispricing dates back to the early study by Ibbotson (1975) who examined a randomly selected sample of 120 IPOs over a period of 1960–1969 and finds them to have been mispriced by an average of 11.40%. Subsequent studies have continued to find that US IPOs are being mispriced: 26.30% (Ritter, 1984), 7.27% (Michaely & Shaw, 1994), 8.08% (Carter et al., 1998), 22.60% (Bradley & Jordan, 2002). 50.40% (Aggarwal, Krigman & Womack, 2002) and 34.80% (Loughran & McDonald, 2013). A list of key studies examining the US market and IPOs' reported mean and median levels of mispricing are provided in Table 4.1. A key feature of IPO mispricing largely overlooked by these studies is the skewness of the distribution, which is clearly observable from the differences between mean and median mispricings. For example, Aggarwal and Rivoli (1990) reported a 10.67% mean and a 1.92% median mispricing in a sample of 1598 IPOs, Krigman et al. (1999) reported a 12.30% mean and a 6.20% median mispricing in a sample of 1232 IPOs, and Loughran and McDonald (2013) reported a 34.80% mean and a 13.30% median mispricing in a sample of 1887 IPOs.

The studies that examine IPO mispricing in the US market have identified various factors that have an effect on the direction of mispricing. The factors that are found to increase mispricing are: higher proportion of ownership retained by issuer

[18] The overpriced IPOs are those that have negative returns, the fairly priced IPOs are those with close to zero returns (between -0.0001% to +0.0001%) and underpriced IPOs are those that have positive returns. These categories are explained in detail in Section 4.4.2 and Table 4.4.

(Beatty & Welch, 1996; Bradley & Jordan, 2002), higher number of risk factors reported in the prospectus (Beatty & Welch, 1996), provision of earnings per share forecast (Loughran & McDonald, 2013), large offer size (Beatty & Welch, 1996; Meigginson & Weiss, 1991), euphoric markets (Ritter, 1984) and listing in the NASDAQ (Bradley & Jordan, 2002). The factors that are found to reduce mispricing are: large firm size (Loughran & Ritter, 2004), greater age of firm (Carter et al., 1998; Dolvin & Jordan, 2008) and smaller offer prices (Beatty & Welch, 1996).

Table 4.1: Mispricing of the US IPOs

Study	Period	N	Mean (%)	Median (%)
Ibbotson (1975)	1960 – 1969	120	11.40	-
Ritter (1984)	1977 – 1982	1,028	26.30	-
Aggarwal & Rivoli (1990)	1977 – 1987	1,598	10.67	1.92
Michaely & Shaw (1994)	1984 – 1988	947	7.27	-
Welch (1996)	1970 – 1989	574	29.60	-
Carter et al. (1998)	1979 – 1991	2,292	8.08	2.38
Krigman et al. (1999)	1988 – 1995	1,232	12.30	6.20
Aggarwal & Conroy (2000)	Mar - Oct, 1997	188	19.47	14.17
Habib & Ljungqvist (2001)	1991 – 1995	1,409	13.80	7.100
Bradley & Jordan (2002)	1990 – 1999	3,325	22.60	10.00
Ritter & Welch (2002)	1980 – 2001	6,249	18.80	-
Aggarwal et al. (2002)	1994 – 1999	618	50.40	23.30
Loughran & Ritter (2004)	1980 – 2003	6391	18.70	6.30
Loughran & McDonald (2013)	1997 - 2010	1,887	34.80	13.30

1. The table summarises evidence of IPO mispricing in the US.

In addition to these factors, entities other than the issuer that are involved in the IPO process (i.e. underwriters and VCs) are also found to impact the level of mispricing. However, the evidence on the direction of this impact is mixed. Earlier studies like Carter and Manaster (1990) and Carter et al. (1998) find that the involvement of a reputable underwriter in the IPO process reduces mispricing. More recent studies find that reputable underwriters are found to increase the level of mispricing (Bradley & Jordan, 2002; Loughran & Ritter, 2002; Dolvin & Jordan, 2008). Similarly, Meigginson and Weiss (1991) find that the involvement of VCs in the IPO process reduces mispricing whereas Dolvin (2005) and Loughran and McDonald (2013) find that IPOs that are backed by VCs exhibit higher mispricing.

4.3 Method

Based on the empirical model given in Equation (3.3) in Chapter 3, we present the empirical model used to examine US IPO mispricing in Equation (4.1). The model

consists of a set of firm-level variables (X_{it}^{j}) and year dummies (X_{it}^{m}). The one variable that is new to the model is the dummy variable *Exchange*$_i$ to control for the listing exchange. *Exchange*$_i$ takes a value of 0 for IPOs listed in the NYSE and 1 for the IPOs listed in the NASDAQ. The definitions of the variables used in Equation (4.1) are given in Table 4.2. Equation (4.1) is set out below:

$$log\ RR_{i,t} = \alpha + \beta_1 logAssets_i + \beta_2 logAge_i + \beta_3 EP\ S_i + \beta_4 RetOwn_i + \beta_5 logOS_i + \beta_6 IM_i + \beta_7 InvOP_i + \beta_8 VC_i + \beta_9 UMS_i + \beta_{10} RF_i + \beta_{11} MP30_i + \beta_{12} Exchange_i + \beta_{13} RelVol_i + \Sigma Year_i + \varepsilon_i \quad (4.1)$$

Table 4.2: Definition of independent variables

Variable	Definitions	Expected Sign
logAssets$_i$	Logarithm of one plus pre-IPO total assets	-
logAge$_i$	Logarithm of the firm's age in years calculated from the difference of the foundation year and the time of the IPO.	-
EPS$_i$	EPS is the forecast earnings per share given in the prospectus.	+
RetOwn$_i$	Calculated as one minus the number of shares issued / total number of shares outstanding.	+
logOS$_i$	Logarithm of offer size measured from the final offer price multiplied by the number of shares offered.	-
IM$_i$	A dummy variable with the value of 1 if the IPO is fixed price offer and 0 for book building offer.	+
InvOP$_i$	One divided by final offer price per share.	-
UMS$_i$	Underwriter Market Share is calculated as the sum of total capital raised in IPOs by the underwriter in a year '*t*', divided by the total capital raised by all the IPOs in the year '*t*'.	+/-
VC$_i$	A dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise.	+/-
RF$_i$	Number of Risk Factors. Measures the risks reported in the IPO prospectus.	+
MP30$_i$	Pre-IPO 30-day performance of FTSE Bursa Malaysia Index.	+
Exchange$_i$	Exchange is a dummy variable with value of 0 for the IPOs listed in the NYSE and 1 for those listed in the NASDAQ.	+
RelVol$_i$	Pre-IPO 30-day realised volatility of the market index where the stock is listed calculated as square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.	+

1. The table summarises the expected signs of the relationship between the independent variables and the first day IPO returns.

4.4 Sample characteristics

4.4.1 Descriptive statistics

Descriptive statistics of the variables for the whole sample are reported in Table 4.3. The average level of mispricing of the US IPOs over the sample period is 34.90% which is close to that reported in other recent studies on the US IPOs such

as, 34.80% reported by Loughran and McDonald (2013). As expected, the median level of mispricing is found to be 2.40% which is much less than the mean mispricing. Out of the sample IPOs, 35.50% of IPOs having less than zero per cent returns (i.e. they are overpriced) and only 18.63% of the IPOs having returns above the average returns. The skewness measure of the distribution is 5.31, suggesting a right-skewed distribution. This finding is consistent with the previous studies both in the US (Table 4.1) and other countries (Table 1.1) which found evidence of skewness in the mispricing distribution but did not examine it.

The average size of the firm at the time of the IPO was US$ 841.25 million, with a median of only US$37.05 million. The average age of the companies in our sample was approximately 15.28 years (7.92 years median) which is slightly higher than 13.60 years previously recorded in the US (e.g. Dolvin & Jordan, 2008) and less than the 14.70 years reported for international IPOs by Engelen and van Essen (2010). The average earnings per share forecast provided by the firms was 27 cents (0 cents median) and the issuing companies retained 11.57% of the ownership on average (0% median) with the companies that retained the highest proportion of ownership being in the manufacturing sector. The companies with the lowest proportions of retained ownership were from the gas distribution sector. The proportion of retained ownership is lower in the US than in the other markets that we studied (see subsequent chapters) but higher than the 3.01% and 3.49% reported by Dolvin (2005) and Loughran and McDonald (2013) respectively. The total money raised by the IPOs over our sample period was USD 284.06 billion with an average offer size of USD 115.50 million (USD 54 million median).

These features show that the characteristics of the firms going public differ widely, as reflected by the difference between the mean and the median. The dominant way of pricing the IPOs is the book building method, with only 20.3% of IPOs using a fixed price. Venture capitalists back 39% of the sample IPOs, slightly lower than the 44.13% reported by Dolvin (2005). The proportion on the IPOs backed by venture capitalists is the highest in the US compared to the other markets that we study. The average number of risk factors reported in the prospectus is 14.18. Lastly, 72.70% of the firms were listed in the NASDAQ.

Table 4.3: Descriptive statistics for full sample

Variables	Mean	St. Dev	Median	Skewness
First day returns (%)	34.90%	179.00%	2.40%	5.31
Offer Price (US$)	14.44	9.90	14.00	20.74
Assets (US$ M.)	841.25	9,786.34	37.05	23.07
Age (years)	15.28	22.16	7.92	3.05
EPS (US$)	0.27	2.22	0.00	34.39
Retained Ownership (%)	11.57%	22.10%	0.00%	2.37
Offer Size (US$ M.)	115.56	277.08	54.00	16.22
Issue Method	0.20	0.40	1.00	-1.48
Inverse offer price	0.08	0.03	0.07	1.61
Underwriter Market Share	0.07	0.09	0.04	2.77
Venture Capitalist	0.39	0.49	0.00	0.45
No. of Risk Factors	14.18	4.34	14.10	-0.09
$MarketPerformance_{t-30}$ (%)	2.14%	4.10%	2.64%	-0.52
Exchange	0.73	0.44	1.00	-1.01
Realised volatility $_{t-30}$ (%)	17.49%	9.61%	14.61%	2.04
No. of IPOs	2,458			

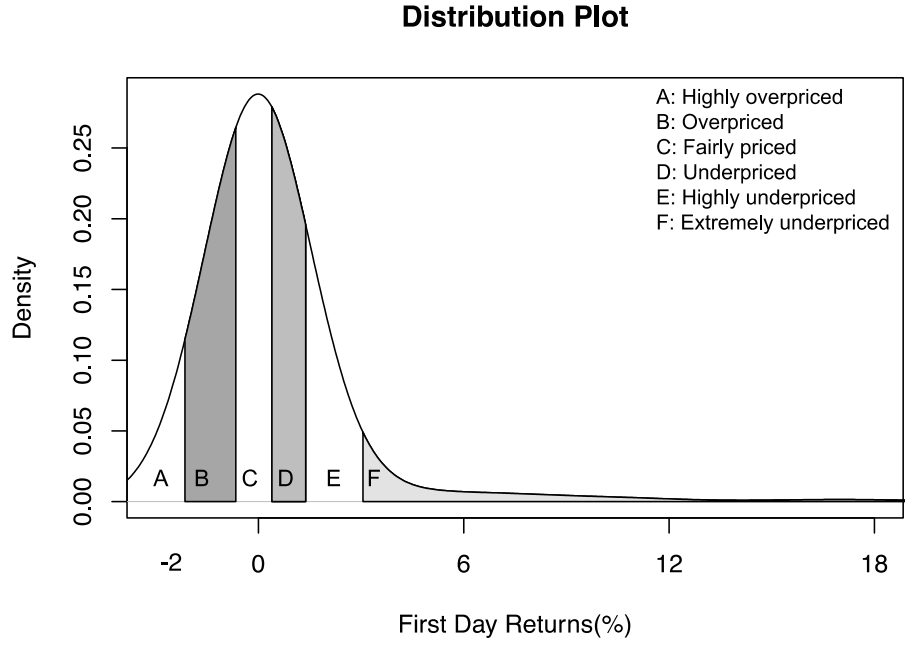
1. The data for the study are from multiple sources. The names, listing dates and data on independent variables of 4014 US IPOs issued during the period from 1995 to 2013 were identified using the SDC Platinum New Issues Database. The data on missing observations is from prospectuses sourced from Thomson One Banker, stock exchange websites and the Jay Ritter database. The daily adjusted trading prices of the stocks included in our sample, the NYSE Composite Index and the NASDAQ Composite Index, which are used as benchmarks for market performance, were collected from DataStream. The construction of the final sample for the analysis involved certain adjustments. The firms with missing data, missing identifiers, unavailable historical prices, unit trusts, stapled securities, issues without a public offer component and ADRs were excluded, leaving a final sample size of 2458 IPOs.
2. The table summarises descriptive statistics of dependent and independent variables used in the study.
3. The first day returns are calculated as (First day closing price – Offer price)/Offer price. Assets are pre-IPO total assets. Age is the firm's age in years calculated at the time of IPO from date of incorporation. EPS earnings forecasts are from IPO prospectuses. Retained Ownership is one minus the number of shares issued over total number of shares outstanding. Offer Size is calculated as the final offer price multiplied by the number of shares offered. Issue Method is a dummy variable with the value of 1 if the IPO is fixed price offer and 0 for book building offer. Inverse offer price is one divided by final offer price per share. UMS is the underwriter's market share calculated through the capital raised by the underwriter in a year divided by capital raised by all the IPOs in that year. Venture Capitalist is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. No. of Risk Factors measures the risks reported in the IPO prospectus. $MarketPerformance_{t-30}$ is pre-IPO 30 days performance of the market index where the stock is listed. Exchange is a dummy variable with value of 0 for IPOs listed on the NYSE and 1 for the IPOs listed on the NASDAQ. $Realised\ Volatility_{t-30}$ is the 30-day pre-IPO volatility of market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.

4.4.2 Levels of mispricing

The descriptive statistics reported in Table 4.3 show the differences between the means and medians and the skewness of the first day returns. This implies a significantly skewed distribution.[19] The right-skewed distribution of the first day IPO returns is clearly observable from the distribution plot in Figure 4.1.

[19] We conducted the Shapiro-Wilk test for normality and Breusch-Pagan-Cook-Weisberg tests for heteroskedasticity and confirmed that the first day returns are not normally distributed.

Figure 4.1: Distribution plot of the US IPO mispricing



Further, Table 4.3 also indicates differences in the characteristics of the IPOs across our sample. In order to get further insights into the characteristics of the IPOs associated with different levels of mispricing, we broke down the mispricing distribution into three segments on the basis of the direction of mispricing – that is, IPOs with negative returns (873 IPOs), IPOs with close to zero returns (187 IPOs) and IPOs with positive returns (1398 IPOs). The IPOs with negative returns were further divided into two categories: highly overpriced IPOs (the top 17.7% of the sample where the IPOs were ranked from the most overpriced to the most underpriced) and overpriced IPOs (ranked observations from 17.7% to 35.5%). The IPOs with close to zero returns, called fairly priced IPOs numbered only 187 and were not further divided (ranked observations from 35.5% to 43%). The IPOs with positive returns were divided into three categories: underpriced IPOs (ranked observations from 43% to 62%), highly underpriced IPOs (ranked observations from 62% to 81%) and extremely underpriced IPOs (probability of ranked observations from 81% to 100%).[20] The means of these mispricing sub-ranges and the corresponding means of the independent variables are reported in Table 4.4.

[20] The distribution of the US IPOs' returns was divided into three categories: IPOs with negative returns, IPOs with zero returns and IPOs with positive returns. There were 873 IPOs with negative returns which were divided into a further two sub-categories: highly overpriced IPOs and overpriced IPOs. There were 1398 IPOs with positive returns which were further divided into three subcategories; underpriced IPOs, highly underpriced IPOs and extremely underpriced IPOs. Finally, there were 187 IPOs with close to zero returns which we refer to as fairly priced IPOs. The quantile points were selected as the mid-points of these sub-categories. The mid-points for the highly overpriced and overpriced IPOs were 0.09 and 0.266 respectively. The mid-point for underpriced IPOs was 0.52, for highly underpriced IPOs it was 0.716 and for extremely underpriced IPOs it was 0.905. Lastly, the mid-point for the fairly priced IPOs was 0.39.

Table 4.4 shows that the characteristics of the IPOs vary across the distribution of the mispricing. The highly overpriced IPOs tended to be the largest firms, and they tended to be old, provide lower earnings forecasts, retain higher proportions of ownership, have the largest offer sizes, be sold at higher offer prices and have less venture capitalist involvement. Compared to the other levels of mispricing, a higher proportion of the highly overpriced IPOs were listed in the NYSE and went public when market volatility was less than average. On the other hand, extremely underpriced IPOs tended to be smaller firms that were younger, provided higher earnings forecasts and had below-average offer sizes. The extremely underpriced IPOs were the firms associated with the highest levels of VC involvement that went public during periods of high market performance and volatility, and were listed in the NASDAQ.

Overall, the patterns show that higher levels of underpricing are associated with the firms that exhibited higher levels of ex-ante uncertainty (Beatty & Ritter, 1986). The underpriced IPOs were relatively fixed in price, which is in line with Ljungqvist et al.'s (2003) suggestion that the fixed price method increases mispricing. We further see an inverse relationship between the level of the first day returns and the offer price. Venture capitalist backing is also more pronounced among underpriced IPOs, which Aggarwal et al. (2002) suggest is beneficial for the issuers and VCs. In line with Loughran and Ritter (2002) we find that reputable underwriters are associated with higher levels of mispricing, whereas IPOs that are underwritten by underwriters with below average market share are associated with mid-ranges of the mispricing.

4.4.3 Mispricing in the NYSE and the NASDAQ

Table 4.5 reports the descriptive statistics of the key variables of the IPOs listed in the NYSE and NASDAQ stock markets. There are some observable differences between the IPO characteristics of the two stock exchanges. The firms listed in the NYSE are 22.7% less mispriced than those listed in the NASDAQ. The NYSE firms exhibit the characteristics of firms that have less ex-ante uncertainty and are expected to be less mispriced. For example, the firms listed in the NYSE are larger in size, are more mature, retain higher proportions of ownership, have larger issue sizes, more frequently use the fixed price method to go public, offer shares at higher offer prices and use more reputable underwriters and less venture capitalist backing.

Table 4.4: Variable means by the extent of mispricing

Variables	**Highly Overpriced**	**Overpriced**	**Fairly Priced**	**Underpriced**	**Highly underpriced**	**Extremely underpriced**
	(0 – 0.177)	**(0.177 – 0.355)**	**(0.355 – 0.43)**	**(0.43 – 0.62)**	**(0.62 – 0.81)**	**(0.81 – 1)**
First day returns (%)	-75.00%	-12.50%	0.00%	4.50%	20.60%	240.30%
Assets (US$ M.)	1,891.66	387.01	674.93	718.52	897.83	420.82
Age (years)	16.67	15.19	13.29	18.29	14.78	12.34
EPS (US$)	0.24	0.24	0.17	0.28	0.23	0.41
Retained Ownership (%)	13.40%	11.10%	7.5%	11.70%	14.00%	9.40%
Offer Size (US$ M.)	171.00	102.42	128.88	112.96	86.98	102.08
Issue Method	0.15	0.21	0.19	0.24	0.22	0.17
Inverse offer price	0.07	0.08	0.09	0.09	0.08	0.08
Underwriter Market Share	0.08	0.07	0.05	0.06	0.06	0.08
Venture Capitalist	0.31	0.36	0.29	0.32	0.45	0.53
No. of Risk Factors	14.21	14.62	13.60	14.11	14.03	14.31
$MarketPerformance_{t-30}$ (%)	2.80%	2.40%	1.30%	2.40%	2.50%	4.30%
Exchange	0.57	0.71	0.66	0.74	0.80	0.81
Realised volatility $_{t-30}$ (%)	16.52%	16.36%	16.56%	16.51%	17.35%	19.92%
No. of IPOs	436	437	187	466	466	466

1. The data sources are consistent with Table 4.3.
2. The table breaks down the levels of first day returns based on the magnitude of mispricing, where 0 to 0.177 refers to highly overpriced IPOs, 0.177 to 0.355 refers to overpriced IPOs, 0.355 to 0.43 refers to fairly priced IPOs, whereas 0.43 to 0.62, 0.62 to 0.81 and 0.81 to 1 refer to underpriced, highly underpriced and extremely underpriced IPOs respectively.
3. The first day returns are calculated as (First day closing price – Offer price)/Offer price. Assets are pre-IPO total assets. Age is the firm's age in years calculated at the time of IPO from date of incorporation. EPS Earnings forecasts are from IPO prospectuses. Retained Ownership is one minus the number of shares issued over total number of shares outstanding. Offer Size is the final offer price multiplied by the number of shares offered. Issue Method is a dummy variable with the value of 1 for IPO fixed price offers and 0 for book building offers. Inverse offer price is one divided by final offer price per share. UMS is the underwriter's market share calculated through the capital raised by the underwriter in a year divided by capital raised by all the IPOs in that year. Venture Capitalist is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. No. of Risk Factors measures the risks reported in the IPO prospectus. $MarketPerformance_{t-30}$ is pre-IPO 30 days performance of the market index where the stock is listed. Exchange is a dummy variable with value of 0 for IPOs listed on the NYSE and 1 for the IPOs listed on the NASDAQ. Realised $Volatility_{t-30}$ is the 30-day pre-IPO volatility of market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.

Table 4.5: Descriptive statistics with respect to the NYSE and the NASDAQ

Variables	NYSE				NASDAQ				NYSE – NASDAQ	
	Mean	**SD**	**Median**	**Skewness**	**Mean**	**SD**	**Median**	**Skewness**	**Mean diff.**	**t-stats**
First day returns (%)	18.40%	169.20%	0.00%	5.06	41.10%	181.70%	5.20%	5.41	-22.70%	-2.90***
Assets (US$ M.)	2,646.08	18,568.03	151.20	12.13	163.56	856.30	30.6	23.59	2,482.52	3.46***
Age (years)	21.83	32.02	8.51	2.01	12.81	16.39	7.86	3.45	9.02	6.95***
EPS	0.33	1.01	0.00	6.70	0.25	2.53	0.00	31.87	0.08	1.15
Retained Ownership (%)	15.30%	28.60%	0.00%	1.90	10.20%	19.00%	0.00%	2.46	5.10%	4.25***
Offer Size (US$ M.)	261.93	476.04	140.00	10.52	60.60	97.65	42.00	14.44	201.33	10.8***
Issue Method	0.25	0.44	1.00	-1.12	0.18	0.38	1.00	-1.65	0.07	3.85***
Inverse offer price	0.06	0.02	0.06	4.43	0.09	0.03	0.08	1.33	-0.03	-22.23***
Underwriter Market Share	0.11	0.10	0.08	1.84	0.05	0.08	0.02	3.59	0.06	12.59***
Venture Capitalist	0.11	0.31	0.00	2.52	0.49	0.50	0.00	0.02	-0.38	-22.94***
No. of Risk Factors	14.14	4.21	14.32	-0.01	14.22	4.50	14.40	-0.11	-0.08	-0.42
$MarketPerformance_{t-30}$ (%)	1.90%	4.20%	2.40%	-0.59	3.10%	7.30%	3.60%	-0.38	-1.20%	-5.36***
Realised volatility $_{t-30}$ (%)	13.66%	6.22%	12.39%	1.78	18.93%	10.24%	15.43%	1.93	-5.27%	-12.48***
No. of IPOs	671				1,787					

1. The data sources are consistent with Table 4.3.
2. The table summarises descriptive statistics of dependent and independent variables of the IPOs listed in the NYSE and the NASDAQ.
3. The first day returns are calculated as (First day closing price – Offer price)/Offer price. Assets are pre-IPO total assets. Age is the firm's age in years calculated at the time of IPO from date of incorporation. EPS Earnings forecasts are from IPO prospectuses. Retained Ownership is one minus the number of shares issued over total number of shares outstanding. Offer Size is measured as the final offer price multiplied by the number of shares offered. Issue Method is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. Inverse offer price is one divided by final offer price per share. UMS is underwriter's market share calculated through the capital raised by the underwriter in a year divided by capital raised by all the IPOs in that year. Venture Capitalist is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. No. of Risk Factors measures the risks reported in the IPO prospectus. $MarketPerformance_{t-30}$ is pre-IPO 30-day performance of the market index where the stock is listed. Realised Volatility $_{t-30}$ is the 30-day pre-IPO volatility of market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.
4. Mean differences significant at the levels of 1%, 5% and 10% are marked by ***, ** and * respectively.

On the other hand, the IPOs listed in the NASDAQ are smaller companies with short operational histories, smaller offer sizes and smaller offer prices. These characteristics are of the firms that tend to have higher ex-ante uncertainty and thus they require higher mispricing. In addition, we find higher performance and more volatility in the NASDAQ prior to the firms going public, which is another factor that contributes to the mispricing of the IPOs listed in the NASDAQ. The differences in the characteristics of the IPOs listed in the two exchanges are significant at the 1% level. However, there are no significant differences in the earnings forecasts and the risk factors provided by the firms listing in the NYSE and NASDAQ stock markets.

4.5 Results and discussion

4.5.1 OLS and median regression estimates

The first column of Table 4.6 reports the OLS regression results of Equation (4.1). The significant estimates are earnings forecast in the prospectus (+), offer price (+), stock exchange (+) and realised volatility (+). Consistent with previous studies, the results suggest that greater mispricing is caused by higher earnings forecasts (Loughran & McDonald, 2013), lower offer prices (Beatty & Welch, 1996; Brennan & Hughes, 1991), listing on the NASDAQ stock market and go public during volatile market periods (Carter et al., 1998).

Comparing the OLS results with the median regression estimates (column 2 of Table 4.6), we can identify a few more variables that have significant effects on the first day returns: pre-IPO total assets (+), retained ownership (+), venture capitalist backing (+), market performance (+), exchange (+) and realised volatility (+). The positive sign for the involvement of venture capitalists and stock exchanges indicates that involvement of a venture capitalist and listing on the NASDAQ stock market increase mispricing. Our finding is consistent with earlier studies as Aggarwal et al. (2002) and Dolvin (2005) argue that mispricing IPOs is beneficial for venture capitalists. This is because, earlier, we observed that the NASDAQ firms have riskier characteristics, and that NASDAQ firms are mostly technology firms and these are the IPOs that require the backing of VCs, which results in higher mispricing of those IPOs (Bradley & Jordan, 2002). This implies that VCs misprice their IPOs to make them attractive to investors and to compensate them for the risk

they take by investing in their IPOs. Finally, the positive and significant coefficients of market performance and realised volatility suggest that the firms that go public during periods of market exuberance exhibit higher mispricing.

We see differences between the OLS and median regression coefficients in terms of magnitude and significance, with some isolated instances of a change in sign. To some extent the findings of median QR provide more detail and are closer to the expected relationships between the independent variables and mispricing. These differences are influenced by non-uniformity in the sample due to the observed skewness in the distribution of IPO returns as well as the strong effect the inflated mean has on the OLS fit. However, since both OLS and median regressions focus on the central tendency of the first day returns distribution, the estimates obtained from these regressions do not allow us to identify the effects of independent variables on different levels of the first day returns of IPOs. In order to overcome these issues and to explore more latent patterns in the relationships between mispricing and independent variables, we employ the QR approach to examine the relationships between the various levels of mispricing (defined in Table 4.4) and explanatory variables.

4.5.2 QR estimates

The QR estimates across the levels of mispricing are reported in columns 3 to 8 in Table 4.6. The QR results confirm our earlier finding that the independent variables have varying impacts across the levels of mispricing. These varying impacts can be observed in the varying sizes, signs and significance of the coefficients as the mispricing levels change across the various ranges examined.

We will first review the findings for each of the independent variables and then discuss the overall perspective as to how the impacts of the independent variables on the underpriced IPOs differ from those on the overpriced IPOs. When looking at OLS estimates for the whole sample, we find no relationship between firm size and IPO mispricing. But now we see that this is not true for all segments of the sample because firm size is found to increase the mispricing of the underpriced and the highly underpriced IPOs. The age of the company undertaking the IPO only has an impact for the extreme levels of mispricing – that is, for highly overpriced and

Table 4.6: OLS and QR estimates

Variables	Full Sample	Median	Highly overpriced	Overpriced	Fairly priced	Underpriced	Highly underpriced	Extremely underpriced
	OLS	**0.5**	**0.09**	**0.266**	**0.39**	**0.52**	**0.716**	**0.905**
(Intercept)	-0.3910***	-0.0625***	-1.5877***	-0.4274***	-0.0858**	-0.0650***	-0.0408*	-0.0429
$logAssets_i$	0.0029	0.0012**	0.0019	0.0011	0.0011	0.0014**	0.0016**	-0.0002
$logAge_i$	0.0231	-0.0034	0.2146***	0.0124	-0.0004	-0.0037	-0.0041	-0.0447**
EPS_i	0.0083*	0.0059***	0.0107**	0.0016	0.0047	0.0058	0.0043***	0.0148
$RetOwn_i$	-0.0643	0.0197*	-0.3007	-0.0041	0.0074	0.0220*	0.0221*	0.0669
$logOS_i$	-0.0046	0.0029	-0.0018	0.0096	0.0027	0.0035**	0.0039*	0.0126
IM_i	0.0187	0.0009	0.0517	0.0062	0.0003	-0.0005	-0.0072	-0.0070
$InvOP_i$	0.9602***	-0.0549	1.8278***	0.3709**	0.0794	-0.0507	-0.0873	0.6413
UMS_i	-0.0099	0.0351	-0.5345*	-0.0595	0.0344	0.0364	0.1272***	0.3058*
VC_i	0.0324	0.0185***	-0.0145	0.0073	0.0088*	0.0192***	0.0331***	0.0540**
RF_i	0.0013	0.0005	0.0065	0.0002	-0.0006	0.0001	0.0001	0.0032*
$MP30_i$	0.1685	0.1286***	0.0390	0.1630	0.1005**	0.1477***	0.2911***	0.1728
$Exchange_i$	0.1516***	0.0219***	0.6703***	0.1273***	0.0245**	0.0217***	0.0378***	0.0063
$RelVol_i$	0.0045**	0.0008***	0.0037	0.0034***	0.0012**	0.0009***	0.0009**	0.0009
YearDummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$Adj.R^2$ / R^1	0.0609	0.0129	0.1539	0.0358	0.0600	0.0150	0.0387	0.0875

1. The data sources are consistent with Table 4.3.
2. Estimated results are from Equation 4.1. The dependent variable is the logarithm of (First day closing price – Offer price)/Offer price. *LogAsset*s is the logarithm of one plus pre-IPO total assets. $LogAge_i$ is the logarithm of the firm's age in years calculated at the time of IPO from date of incorporation. EPS_i is forecast earnings per share given in the prospectus. $RetOwn_i$ is calculated as one minus the number of shares issued over total number of shares outstanding. $logOS_i$ is the logarithm of offer size measured from the final offer price multiplied by the number of shares offered. IM_i is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. $InvOP_i$ *is* one divided by final offer price per share. UMS_i is calculated as the sum of total capital raised in IPOs by the underwriter in the year *t*, divided by the total capital raised by all the IPOs in the year *t*. VC_i is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. RF_i is the number of risk factors reported in the IPO prospectus. $MP30_i$ is pre-IPO 30-day performance of the market index where the stock is listed. $Exchange_i$ is a dummy variable with value of 0 for IPOs listed on the NYSE and 1 for the IPOs listed on the NASDAQ. Realised Volatility $_{t-30}$ is the 30-day pre-IPO volatility of market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.
3. The first column provides the OLS estimates from Equation 4.1
4. Column 2 provides median quantile estimates. Columns 3–6 provide QR estimates for the quantile points selected as mid-points of the sub-ranges defined in Table 4.4.
5. Coefficients significant at the levels of 1%, 5% and 10% are marked by ***, ** and * respectively.
6. *Adjusted* R^2 is a goodness of fit measure for OLS and R^1 is a goodness of fit measure for QR based on Koenker and Machado (1999).

extremely underpriced IPOs. In the case of highly overpriced IPOs, the age of the firm has a significantly positive impact on mispricing. However, the effect becomes significantly negative for the extremely underpriced IPOs. Hence, we do see that company age increases the size of the mispricing of the IPOs in both directions. This finding has two implications. First, a plausible reason behind older firms increasing overpricing is that the investors put a lower value on firms with longer operational histories, leading to overpricing (Lin, Cai & Li, 1998). In contrast, younger firms are underpriced to compensate investors for the risk they take in investing in a firm with a shorter operating history (Loughran & Ritter, 2004).

The results of the OLS and median regression show that the size of the earnings per share forecast is positively correlated with the first day returns. When we undertake a finer analysis we see that this really only applies in the case of the highly overpriced and highly underpriced IPOs that are positively affected by the size of the earnings forecast. Similarly, the ownership retained by the issuers has a significantly positive impact only on two levels of mispricing – that is, the underpriced and highly underpriced IPOs. This is consistent with Leland and Pyle (1977) and Beatty and Welch (1996) who find that higher levels of retained ownership increase mispricing. The rationale behind this is that issues tend to sell their IPOs at lower price so that when IPO shares gain higher prices in the aftermarket, this also increases the value of the shares retained by the issuers (Bradley & Jordan, 2002; Loughran & Ritter, 2004).

Consistent with Michaely and Shaw (1994), the size of the offer also has a significantly positive relationship with underpriced and highly underpriced IPOs, suggesting that the extremes of underpricing being more associated with the larger issues. The firms with larger offer size may face subscription uncertainty, for which they underprice their IPOs to ensure that the IPO is subscribed. The method of going public has no significant impact across the various levels of mispricing. The offer price has a significantly positive impact on the highly overpriced and the overpriced IPOs, suggesting that lower offer prices increase overpricing. As suggested by Beatty and Welch (1996), lower offer prices cause an increase in transaction costs and thus investors pay less for such stocks, leading to lower first day returns.

The reputation of the underwriter is found to contribute to higher mispricing in the case of highly underpriced and extremely underpriced IPOs. Consistent with Loughran and Ritter (2004) and Dolvin and Jordan (2008), underwriter reputation increased the mispricing of highly underpriced IPOs. However, underwriter reputation had a significantly negative impact on the highly overpriced IPOs. There was a positive and significant impact of VC_i on all levels of the underpriced IPOs, but it had no impact on the overpriced and the highly overpriced IPOs, confirming our earlier finding that the involvement of VC increases mispricing. Although this contradicts Megginson and Weiss (1991), it is consistent with Hamao et al. (2000) and Brav and Gompers (2003) who find that VC-backed IPOs are more mispriced. The number of risk factors reported in prospectuses does not seem to impact IPO mispricing except for the extremely underpriced IPOs where the risk factors have a significantly positive relationship with overpricing. This suggests that the IPOs that are deemed risky by the issuers (and underwriters and VC) require higher mispricing as compensation for the risk investors take by investing in those IPOs. At the same time, issuers tend to leave money on the table to avoid litigation from unhappy investors (Beatty & Ritter, 1986; Beatty & Welch, 1996). We further find that the IPOs that go public during periods of high market performance are more mispriced. This confirms that IPO mispricing can be driven by euphoric markets, as argued by Ritter (1984). In addition, higher market volatility is also found to increase the level of mispricing. This relationship is present at all the levels of mispricing except for the tail regions – that is, highly overpriced and extremely underpriced IPOs. Lastly, consistent with Bradley and Jordan (2002) and our discussion for Table 4.5, the level of mispricing is higher for the IPOs listed on the NASDAQ than for those listed on the NYSE.

The QR results show that the relationships between the independent variables and mispricing vary across the levels of mispricing. The results are consistent with expectations and the prior literature, and they provide new insights into the mispricing behaviour of IPOs. The effects of the factors that explain the mispricing of IPOs on the left-hand side of the distribution (i.e. overpriced IPOs) are different from the factors that explain the mispricing of the IPOs on the right-hand side of the distribution (i.e. underpriced IPOs). The mispricing of the overpriced IPOs is significantly impacted by age of the firm going public, provision of higher earnings forecast, higher offer price, underwriter reputation and the listing exchange. On the

other hand, the underpriced and highly underpriced IPOs are driven by firm size, retained ownership, offer sizes, reputable underwriters, venture capitalist involvement, high market returns, high market volatility and listing on NASDAQ. The two categories of mispricing that exhibit distinct characteristics are the fairly priced and the extremely underpriced IPOs. The fairly priced IPOs are those that are impacted by positive market performance, VC backing and NASDAQ listing but fail to trigger a reaction from the market. Lastly, the extremely underpriced IPOs are explained by firm age, underwriter reputation, VC backing and high number of risk factors. Although these companies also go public during periods of high market performance and high volatility, the relationships with these variables are statistically insignificant. This suggests that the extremely underpriced IPOs experience high mispricing because of their risk characteristics which require their issuers to leave money on the table.

Overall, our results show that independent variables impact differently across the levels of mispricing. Table 4.7 presents the F-statistics of the equality of slope parameters across the levels of mispricing that we examine. The test identifies the differences between the slope estimates for the various levels of the mispricing distribution. These differences are significant at the 1% level. These tests show differences between the IPOs in two extreme regions, the highly overpriced and the extremely underpriced IPOs. This confirms that the impact that the independent variables have on various levels of mispricing are significantly different across the mispricing distribution and this supports our use of the QR to explore those differences.

Table 4.7: Tests of the equality of slope estimates across quantiles

Levels of mispricing	Quantiles	Estimate	p-value
Highly overpriced vs. extremely underpriced	0.09 vs. 0.905	17.78	0.000***
Overpriced vs. highly underpriced	0.266 vs. 0.716	7.78	0.000***
Fairly priced vs. underpriced	0.39 vs. 0.52	1.80	0.004***
All levels of mispricing	0.09 vs. 0.266 vs 0.39 vs. 0.52 vs 0.716 vs. 0.905	27.88	0.000***

1. The table shows the F-statistics of the equality of slope estimates across the selected quantiles representing the levels of the first day returns.
2. Coefficients significant at the levels of 1%, 5% and 10% are marked by ***, ** and * respectively.

4.6 Conclusion

This chapter examines the mispricing of US IPOs across various levels. Using a sample of 2458 IPOs issued from 1995 to 2013, we find a mean mispricing of 34.90% and a median of 2.40%. We find that the distribution of the returns is skewed to the right. This led us to separately examine various levels of highly overpriced, overpriced, fairly priced and underpriced, highly underpriced and extremely underpriced IPOs.

We find that there is a non-uniform relationship between the level of mispricing and factors that explain the mispricing. We examine these relationships using the QR approaches with the OLS being reported for comparison purposes. The OLS estimates only explain the relationships in the central region of the distribution, highlighting earnings per share forecast, offer price, listed exchange and realised volatility as factors that significantly increase mispricing. In contrast, the median QR results provide more insights into the effects that the independent variables have on the mispricing. The median QR results show that, in addition to the OLS estimates, firm size, firm age, retained ownership, underwriter reputation, involvement of venture capitalist and high market performance also significantly explain the mispricing. The QR estimates highlight the relationship between the mispricing and the independent variables that were not otherwise captured by the OLS regression. For example, the OLS results indicate that firm age and underwriter reputation had no significant impact on mispricing, but the QR results show that this is not entirely true as firm age has a significant impact on the highly overpriced and the extremely underpriced IPOs, and underwriter reputation has a significant impact on the highly overpriced, highly underpriced and extremely underpriced IPOs.

We provide new insights into the relationship between IPO mispricing and the factors that are found to explain the mispricing. By applying the QR approach we show that the independent variables have varying relationships with different levels of mispricing. This variation is more pronounced at the tails of the distribution. For example, the IPOs that are highly overpriced are significantly impacted by operational history, earnings per share forecast, offer price, underwriter reputation and listing exchange, suggesting that investors put lower prices on these firms compared to the prices the issuers assign to them. In these IPOs, the issuers gain

more wealth at the expense of the investors. On the other hand, the extremely underpriced IPOs are significantly impacted by VC backing, underwriter reputation, operational history and report higher number of risk factors in the prospectus. These factors suggest that the VCs make risky IPOs more attractive by underpricing them. Lastly, the fairly priced IPOs tend to be the firms that are driven by VC backing, market performance and exchange listings which fail to trigger a reaction in the aftermarket.

Chapter 5: Mispricing in Australia

5.1 Introduction

This chapter examines the mispricing of 1095 IPOs issued in Australia between 1995 and 2013. We find that the average level of mispricing is 25.51% which is consistent with the findings in many previous studies. However, the distribution of first day returns is heavily skewed to the right with 37.30% IPOs being overpriced and only 16% of IPOs realising a first day return greater than the average first day return. Therefore, it is not surprising that the median first day return of 10% is much less than the average first day return (25.51%). We suggest that in this instance, the mean gives an inflated view of the extent of this mispricing and that the median mispricing of 10% provides a better measure of central tendency for the first day IPO returns.

Like the US IPOs, we find divergence in mispricing of the Australian IPOs. To examine this divergence, we divide the mispricing distribution into various levels based on the magnitude and direction of the mispricing. The levels of mispricing for the Australian IPOs are highly overpriced, overpriced, fairly priced, underpriced, highly underpriced and extremely underpriced.[21] The characteristics of IPOs are different for each level of mispricing. For example, the highly overpriced IPOs are larger and older companies that provide earnings forecasts. Further, older companies with larger offer sizes that sell shares at lower offer prices and involve a financial institution in the role of an underwriter are less mispriced. However, the highly underpriced and extremely underpriced IPOs tend to be associated with the risky firms that involve an underwriter, report higher numbers of risk factors and seldom provide earnings forecasts. Lastly, we also find that most of the firms time their IPOs during periods of higher market performance.

The Australian market differs from the US market in various respects. For instance, unlike the US, the fixed price method is the commonly used pricing method in Australia and only a nominal number of the issuers use the book building method. A number of the issuers do not include earnings forecasts in their IPO prospectuses

[21] Overpriced IPOs are those that have negative returns, fairly priced IPOs are those with close to zero returns (between -0.0001% to +0.0001%) and underpriced IPOs are those that have positive returns.

as they are allowed under Australian Securities and Investment Commission (ASIC) Regulatory Guide 170 to choose not to include less reliable earnings forecasts. Another key difference is that financial institutions in Australia perform roles in the IPO process ranging from the typical functions performed by underwriters to acting as advisers for the issues. Thus, it is quite common for those undertaking an Australian IPO to not engage a financial institution as an underwriter.

5.2 Studies on Australia

In Australia, the evidence of mispricing dates back to Finn and Higham (1988) who find that IPOs are on average mispriced by 29.20%. Finn and Higham examined 93 IPOs over the period from 1966 to 1978. Table 5.1 provides a summary of evidence of the mispricing of Australian IPOs from Australian studies over different time periods. The mispricings range from 11.90% (Lee et al., 1996) to 49.98% (How & Howe, 2001).

Table 5.1: Mispricing of Australian IPOs

Study	Period	N	Mean (%)	Median (%)
Finn & Higham (1988)	1966 – 1978	93	29.20	-
How et al. (1995)	1980 – 1990	340	19.74	10.00
Lee et al. (1996)	1976 – 1989	266	11.90	-
How & Howe (2001)	1979 – 1990	396	49.98	12.69
Dimovski & Brooks (2004)	1994 – 1999	358	25.60	-
Bayley, Lee & Walter (2006)	1995 – 2000	182	26.72	8.24
Dimovski & Brooks (2008)	1994 – 2004	834	22.40	7.60
Gygax & Ong (2011)	2001 – 2005	468	21.69	-
Dimovski, Philavanh & Brooks (2011)	1994 – 2004	380	29.60	-
Bird & Ajmal (2016)	1995 – 2013	1,095	25.51	8.62

1. The table summarises evidence of IPO mispricing in Australia.

Similar to the general observation about studies that examine mispricing (see Table 1.1), Australian studies also overlook the skewness that is present in the mispricing distributions. This is apparent from the differences between the mean and the median levels of mispricing reported in Table 5.1. For example, How et al. (1995) examine a sample of 340 IPOs issued from 1980 to 1990 that are mispriced by an average of 19.74% and have a median of 10%. How and Howe (2001) report mean and median mispricings of 49.98% and 12.69% respectively in a sample of 396 IPOs issued between 1979 and 1990.

Beatty and Ritter (1986) argue that the key driver of mispricing is information asymmetry and uncertainty surrounding an IPO and these are also found to impact the mispricing of Australian IPOs. Various firm-level factors have been identified that impact the level of mispricing. These factors are both endogenous and exogenous to the firm conducting the IPO. The factors that are found to increase the level of mispricing are: retained ownership (Lee et al., 1996), risk factors reported in prospectus (Gygax & Ong, 2011) and recent market performance (Dimovski & Brooks, 2004; Dimovski et al., 2011). On the other hand, the factors that are found to reduce the mispricing of the Australian IPOs are: retained ownership (Dimovski & Brooks, 2004), offer size (Dimovski & Brooks, 2004), offer price (Gygax & Ong, 2011) and VC certification (Gygax & Ong, 2011). Evidence of the impact of underwriter certification on mispricing in Australia, like the evidence in the US, is mixed. How et al. (1995) find that the involvement of a financial institution as an underwriter reduces mispricing, whereas recent studies by Dimovski and Brooks (2004) and Gygax and Ong (2011) find that IPOs being underwritten increases mispricing.

5.3 Method

Following the discussion in Section 3.4 and the base model given in Equation (3.3), the empirical model for examining the Australian IPOs is stated in Equation (5.1). We use X_{it}^{j}, the firm-level explanatory variables (discussed in Section 3.2.2) and year dummies, X_{it}^{m}, to control for time effects. In addition, changes are made to two of the independent variables to capture Australian institutional practices. First, since it is not mandatory for Australian issuers to provide earnings per share forecast in the IPO prospectus, we use a dummy variable with a value of 1 if the earnings forecast is provided in the IPO prospectus and 0 otherwise, and is expected to reduce mispricing. Second, the Australian issuers may choose not to involve a financial institution as an underwriter; therefore we use a dummy variable with a value of 1 if a financial institution is involved as an underwriter and 0 otherwise. The definitions of the independent variables and the expected signs of their relationships with the first day IPO returns are summarised in Table 5.2. The expected signs are based on the relationships reported in previous studies.

$$log\ RR_{i,\ t} = \alpha + \beta_1 logAssets_i + \beta_2 logAge_i + \beta_3 EPS_i + \beta_4 RetOwn_i + \beta_5 logOS_i + \beta_6 IM_i + \beta_7 InvOP_i + \beta_8 VC_i + \beta_9 UW_i + \beta_{10} logRF_i + \beta_{11} MP30_i + \beta_{11} RelVol_i + \Sigma Year_i + \varepsilon i \quad (5.1)$$

Table 5.2: Definitions of independent variables

Variable	Definitions	Expected Sign
$logAssets_i$	Logarithm of one plus pre-IPO total assets	-
$logAge_i$	Logarithm of the firm's age in years calculated from the difference of the foundation year and the time of the IPO.	-
EPS dummy$_i$	A dummy variable with the value of 1 if earnings forecast is provided in the prospectus and 0 otherwise.	-
$RetOwn_i$	Calculated as one minus the number of shares issued / total number of shares outstanding.	-
$logOS_i$	Logarithm of offer size measured from the final offer price multiplied by the number of shares offered.	-
IM_i	A dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers.	+
$InvOP_i$	One divided by final offer price per share.	-
UW_i	A dummy variable with a value of 1 if a financial institution is involved as an underwriter and 0 otherwise.	+/-
VC_i	A dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise.	-
$logRF_i$	Logarithm of the number of risk factors reported in the IPO prospectus	+
$MP30_i$	Pre-IPO 30-day performance of ASX All Ordinaries Index.	+
RelVol	Pre-IPO 30-day realised volatility of the market index where the stock is listed calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.	+

1. The table summarises the expected signs of the relationship between the independent variables and the first day IPO returns.

5.4 Sample characteristics

5.4.1 Descriptive statistics

Descriptive statistics of the main variables for the whole sample are reported in Table 5.3. The average mispricing is 25.51% with a median of 10%. The distribution of the first day returns is heavily skewed to the right with 37.30% of the sample IPOs being overpriced, and only 16% of the sample yielding returns above the average returns. The IPO shares are offered at an average price of AUD 0.52. The average size of assets of the firms before they go public is AUD 175.40 million. Although on average Australian firms undertaking an IPO are five years old (one-third of the average age of the firms going public in the US), over 40% of Australian firms undertaking an IPO are less than one year old. Earnings per share

forecast are provided by 35.40% of the firms in our sample. The issuing companies retain 57% of the ownership on average, with those companies with the highest levels of retained ownership being in the hotel industry, and those with the lowest levels being in the financial sector. Only 37.20% of the IPOs in our sample had a financial institution in the role of an underwriter which is lower than the 64.74% reported by Gygax and Ong (2011). The reason for this difference is the period examined. Gygax and Ong examine IPOs that were issued from 1996 to 2006 whereas our sample consists of IPOs that were issued from 1995 to 2013, and the Australian market has experienced a significant decline in the proportion of the IPOs being underwritten. In 1995 the figure was 83.30% and it fell as low as 19.70% in 2010.

Table 5.3: Descriptive statistics of the Australian sample

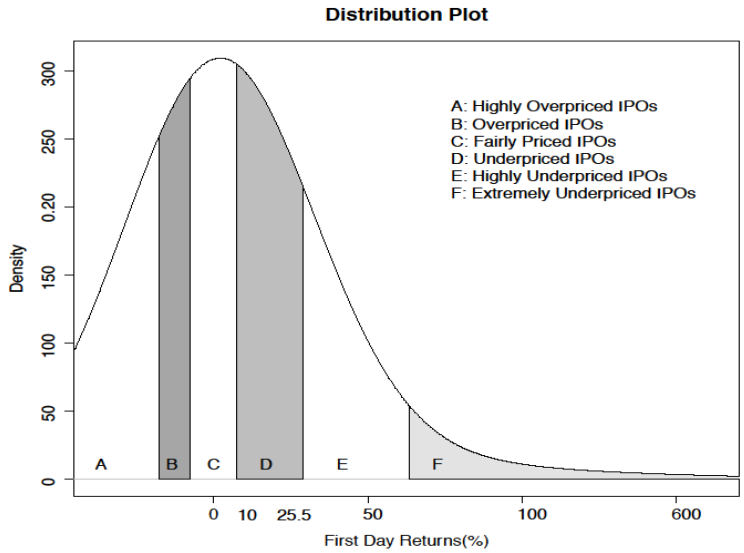
Variables	Mean	St. Dev.	Median	Skewness
First day returns (%)	25.51%	83.87%	10.00%	4.78
Offer Price ($)	0.51	0.78	0.20	9.47
Assets ($M.)	175.40	3,101.30	1.06	27.81
Age (years)	5.00	11.11	1.42	5.73
EPS Dummy	0.35	0.47	0.00	0.61
Retained Ownership (%)	57.60%	19.80%	58.00%	-0.45
Offer Size ($M.)	36.63	206.54	6.00	13.57
Issue Method	98.30	12.27	1.00	-7.61
Inverse offer price	3.63	172.60	5.00	-0.75
Underwriter Dummy	0.37	0.48	0.00	0.53
Venture Capitalist	0.02	0.14	0.00	6.54
No. of Risk Factors	13.32	7.28	13.00	0.86
$MarketPerformance_{t-30}$ (%)	7.29%	64.90%	16.00%	-0.84
Realised Volatility $_{t-30}$ (%)	12.84%	5.80%	11.06%	1.84
No. of IPOs	1,095			

1. The data for the study are obtained from multiple sources. The 1361 Australian IPOs issued during the period of 1995–2013 (and their listing dates) were identified using the Morningstar Global Database. The offer prices of the IPOs and the independent variables were obtained from the IPOs' prospectuses which are available on the Thomson One Banker website and the Australian Securities Exchange (ASX) website. The daily adjusted trading prices of the stocks included in our sample and the ASX All Ordinaries Index, which is used as a benchmark for market performance and calculation for realised volatility, were collected from DataStream. The construction of the final sample for the analysis involved certain adjustments. We excluded: firms for which prospectuses or historical prices were not available, unit trusts, stapled securities, issues without public offer components and CHESS Depository Interests (CDIs). This left a final sample size of 1095 IPOs.
2. The table summarises descriptive statistics of dependent and independent variables used in the study.
3. The first day returns are calculated as (First day closing price – Offer price)/Offer price. Offer price is the price at which IPO shares are offered for subscription to investors. Assets are pre-IPO total assets. Age is the firm's age in years calculated at the time of IPO from date of incorporation. EPS Dummy equals 1 if an earnings forecast is provided in the prospectus and 0 otherwise. Retained Ownership is one minus the number of shares issued over total number of shares outstanding. Offer Size is measured as the final offer price multiplied by the number of shares offered. Issue Method is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. Inverse offer price is one divided by the final offer price per share. Venture Capitalist is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. Underwriter Dummy equals 1 if a financial institution is involved in the role of an underwriter and 0 otherwise. No. of Risk Factors measures the risks reported in the IPO prospectus. $MarketPerformance_{t-30}$ is the pre-IPO 30-day performance of the ASX All Ordinaries Index. Realised Volatility $_{t-30}$ is the 30-day pre-IPO volatility of the market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.

5.4.2 Levels of mispricing

The mean mispricing is 25.51% and the median is 10% with a skewness measure of 4.78. The distribution of the mispricing is presented in Figure 5.1, which shows a right-skewed distribution. The presence of skewness is confirmed by the Shapiro-Wilk test which rejects the null hypothesis that the mispricing distribution is normally distributed. The departure from normality highlights the need to examine the latent characteristics of the mispricing distribution. For this, we divide our IPOs in accordance with the extent and sign of their mispricing in order to better analyse the factors that drive different levels of mispricing. There are 408 overpriced IPOs which are divided into two equal sub-categories: highly overpriced and overpriced IPOs. There are 630 IPOs with positive returns which are divided into three equal subcategories: underpriced IPOs, highly underpriced IPOs and extremely underpriced IPOs. Finally, there are 57 IPOs with close to zero returns which we refer to as fairly priced IPOs.[22] The average mispricing of these sub-ranges is reported in Table 5.4. It is worth noting that the difference between the mean and median levels of mispricing is largely driven by the extremely underpriced IPOs (approx. 19% of the sample) which are on average mispriced by 133.20%.

Figure 5.1: Distribution plot showing Australian IPO mispricing



[22] The IPOs whose first day returns are between -0.0001 to +0.0001 are treated as close to zero returns.

Table 5.4: Variable means by the extent of mispricing of Australian IPOs

Variables	**Highly overpriced**	**Overpriced**	**Fairly priced**	**Underpriced**	**Highly underpriced**	**Extremely underpriced**
	(0 - 0.186)	**(0.186 - 0.377)**	**(0.377 - 0.423)**	**(0.423 – 0.616)**	**(0.616 – 0.808)**	**(0.808 – 1)**
First day returns (%)	-38.60%	-9.60%	0.00%	11.10%	48.30%	133.20%
Assets ($M.)	80.56	96.16	4.06	61.77	202.36	489.23
Age (years)	5.48	4.79	2.65	5.17	5.32	4.87
EPS Dummy	0.29	0.36	0.32	0.37	0.49	0.26
Retained Ownership (%)	56.80%	54.50%	53.20%	58.10%	60.50%	59.10%
Offer Size ($M.)	33.10	76.86	19.45	29.17	21.55	26.92
Issue Method	0.98	0.97	1.00	0.98	0.98	0.98
Inverse Offer Price	3.92	3.59	4.29	3.64	3.24	3.61
Underwriter Dummy	0.34	0.44	0.29	0.34	0.40	0.36
Venture Capitalist	0.02	0.02	0.00	0.02	0.04	0.01
No. of Risk Factors	12.73	14.01	14.09	13.47	12.54	13.56
Market Performance $_{t-30}$ (%)	-7.27%	-1.48%	-0.69%	10.93%	20.56%	17.47%
Realised Volatility $_{t-30}$ (%)	13.99%	12.76%	14.38%	12.93%	12.62%	11.49%
No. of IPOs	204	204	57	210	210	210

1. The data sources are consistent with Table 5.3.
2. The table breaks down the means of the variables for various sub-ranges based on the magnitude of the mispricing of the IPOs as follows: the highly overpriced IPOs (i.e. the top 18.6% of the sample when the IPOs are ranked from the most overpriced to the most underpriced), the overpriced IPOs (ranked from 18.6% to 37.7%), the fairly priced IPOs (ranked 37.7% to 42%), the underpriced IPOs (ranked from 42.3% to 61.6%), the highly underpriced (ranked 61.6% to 80.8%) and the extremely underpriced (ranked 80.8% to 100%).
3. The first day returns are calculated as (First day closing price – Offer price)/Offer price. Assets are pre-IPO total assets. Age is the firm's age in years calculated at the time of IPO from date of incorporation. EPS Dummy equals 1 if an earnings forecast is provided in the prospectus and 0 otherwise. Retained Ownership is one minus the number of shares issued over total number of shares outstanding. Offer Size is measured as the final offer price multiplied by the number of shares offered. Issue Method is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. Inverse offer price is one divided by final offer price per share. Venture Capitalist is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. Underwriter Dummy equals 1 if a financial institution is involved in the role of an underwriter and 0 otherwise. No. of Risk Factors measures the risks reported in the IPO prospectus. MarketPerformance$_{t-30}$ is the pre-IPO 30-day performance of ASX All Ordinaries Index. Realised Volatility $_{t-30}$ is the 30-day pre-IPO volatility of market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.

As can be seen from Table 5.4, there is a wide variation in the magnitude of the first day returns across our six sub-ranges as well as in the characteristics of the IPOs associated with those levels of mispricing. The highly overpriced IPOs are older companies with larger offer sizes that are less likely to provide earnings forecasts in the prospectus and go public during periods of negative market performance and higher volatility. The highly underpriced and extremely underpriced IPOs tend to be larger firms that are likely to provide earnings forecasts in their prospectuses. These firms have relatively smaller offer sizes, higher offer prices, tend to involve a financial institution in the role of an underwriter, have involvement of a venture capitalist and go public during a period of good market performance and less volatility.

Lastly, the fairly priced IPOs tend to be young and smaller companies that have smaller offer sizes and offer prices, have no venture capitalist involvement and are less likely to involve a financial institution in the role of an underwriter. These IPOs go public during periods of highly negative market performance and highly volatile markets. The characteristics of the firms that do not vary significantly across the levels of mispricing are retained ownership, issue method and number of risk factors reported in the prospectus.

5.5 Results and discussion

5.5.1 OLS and median regression estimates

The first column of Table 5.5 reports the OLS estimates of Equation (5.1). The significant variables are age (-), the provision of earnings estimates (-), the number of risk factors provided (+), and the recent performance of the market (+). Consistent with Beatty and Ritter (1986), these findings suggest that ex-ante uncertainty between sellers and investors is a key driver of mispricing.

Comparing the OLS estimates with the median QR estimates reported in the second column of Table 5.5, two variables which are significant under the OLS regression remain the same: age (-) and market performance (+). Distinct from OLS, the median QR shows the significance of three variables: offer size (-), offer price (-) and whether the IPO is underwritten (-). Consistent with literature, the estimates suggest that larger amounts of funds raised by the IPO and lower issue prices

reduce mispricing. This could be because, as suggested by Beatty and Welch (1996), setting a lower offer price exposes an IPO to more outside scrutiny and reduces the need for mispricing. Also, consistent with the signaling model and the certification hypothesis, the involvement of a financial institution as an underwriter providing certification to investors regarding the quality of the issue results in lower mispricing. These results are consistent with explanations that higher information asymmetry increases mispricing, and that certification of an IPO by a financial institution reduces mispricing (Campbell & Kracaw, 1980; Booth & Smith, 1986). The analysis suggests that the factors that increase the mispricing of IPOs include: younger age at the time of IPO (Lee et al., 1996), no involvement of an underwriter (How et al., 1995), smaller offer size (Dimovski & Brooks, 2008), and higher offer price (Brennan & Hughes, 1991). These are characteristics of IPOs where investors might feel that they are at an information disadvantage and therefore require higher mispricing. Further, signs of previous positive market performance suggest that euphoric markets cause higher levels of mispricing (Dimovski et al., 2011).

We see differences between estimates of the OLS and median QR in terms of sign, magnitude and significance. These differences have significant implications. First, the median QR regression identifies more factors that impact the mispricing which is a finding that is consistent with prior studies. Second, the differences in the results are consistent with Table 5.4 but are not captured by the OLS. For example, Table 5.4 shows that IPOs with smaller offer sizes and larger offer prices tend to be more mispriced, a relationship that is captured by the median QR but is not captured by the OLS. Similarly, the OLS finds no significant relationship between the involvement of an underwriter and mispricing whereas the median QR suggests that no involvement of financial institutions as underwriters increases mispricing. Further, the comparison of the OLS coefficients with the QR coefficients (columns 3–8 of Table 5.5, to be discussed in the next section) shows that the OLS estimates match closely with the estimates of the right tail of the distribution (the extremely underpriced IPOs). This suggests that the OLS regression coefficients are driven by the strong impact of the extremely underpriced IPOs on the least squares fit and the asymmetric density of the sample distribution. It should be noted that both the OLS and median QR approaches focus on the central tendency of the sample distribution and do not enable us to explore the impact that the independent variables have on

Table 5.5: OLS and QR estimates

Variables	Full Sample	Median	Highly overpriced	Overpriced	Fairly priced	Underpriced	Highly underpriced	Extremely underpriced
	OLS	**0.5**	**0.093**	**0.281**	**0.4**	**0.518**	**0.712**	**0.904**
(Intercept)	0.2504	0.3967***	-0.5094	0.2006*	0.2893***	0.4222***	0.4005	1.6318**
$logAssets_i$	0.0141	0.0010	0.0216***	0.0029	0.0049	0.0019	0.00412	-0.0057
$logAge_i$	-0.0391*	-0.0173***	-0.0579***	-0.0198***	-0.0162**	-0.0134*	-0.0138	-0.0047
EPS_i	-0.1089***	-0.0046	0.0457**	0.0138	0.0086	-0.0058	-0.0809***	-0.2690***
$RetOwn_i$	0.1129	0.0549	0.0131	0.0117	0.0280	0.0381	0.0529	0.1558
$logOS_i$	-0.0258	-0.0406***	0.0101	-0.0352***	-0.0463***	-0.0448***	-0.0403	-0.0607
IM_i	0.0098	-0.0039	-0.0621	-0.0042	-0.0069	0.0061	0.0833	0.0998
$InvOP_i$	0.0005	-0.0166***	0.0260	-0.0126***	-0.0157***	-0.0182***	-0.0225**	-0.0151
UW_i	-0.0488	-0.0188**	0.0224	-0.0028	-0.0156*	-0.0219**	-0.0701**	-0.1003**
VC_i	0.0229	0.0353	-0.0315	0.0052	0.0258	0.0281	-0.0161	-0.1201
$logRF_i$	0.1752***	0.0072	-0.0020	0.0102	0.0032	0.0071	0.0439	0.3667***
$MP30_i$	0.0053**	0.0034***	0.0009	0.0034***	0.0034***	0.0035***	0.0051**	0.0123**
$RelVol_i$	-0.3822	-0.0008	0.0004	-0.0011	-0.0012	-0.0738	-0.0614	-0.2229
YearDummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$Adj.R^2$ / R^1	0.081	0.031	0.050	0.026	0.030	0.030	0.078	0.219

1. The data sources are consistent with Table 5.3.
2. Estimated results are from Equation 5.1. The dependent variable is the log of (First day closing price – Offer price)/Offer price. *LogAssets* is the logarithm of one plus pre-IPO total assets. *LogAge* is the logarithm of the firm's age in years calculated at the time of IPO from date of incorporation. *EPS* is a dummy variable with the value of 1 if an earnings forecast is provided in the prospectus and 0 otherwise. *RetOwn* is calculated as one minus the number of shares issued over total number of shares outstanding. *LogOS* is the logarithm of offer size measured from the final offer price multiplied by the number of shares offered. *IM* is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. *InvOP is* one divided by final offer price per share. *VC* is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. *UW* is a dummy variable with a value of 1 if a financial institution is involved in the role of an underwriter and 0 otherwise. *LogRF* is the logarithm of the number of risk factors reported in the IPO prospectus. *MP30* is pre-IPO 30-day performance of the ASX All Ordinaries Index. *RelVol* is the realised volatility of the market index over the 30 days prior to the IPO.
3. The first column provides the OLS estimates from Equation 5.1.
4. Column 2 provides median quantile estimates. Columns 3–8 provide QR estimates for the quantile points selected as mid-points of the sub-ranges defined in Table 5.4.
5. Coefficients significant at the levels of 1%, 5% and 10% are marked by ***, ** and * respectively.
6. *Adjusted* R^2 is a goodness of fit measure for OLS and R^1 is a goodness of fit measure for QR based on Koenker and Machado (1999).

the various levels of mispricing. We address this issue by examining the impact of the independent variables on different levels of mispricing that are set in Table 5.4.

5.5.2 QR estimates

The information presented in Table 5.4 suggests that the impacts that the explanatory variables have on different levels of the first day returns might vary. In order to investigate the effects, we focus on six categories of IPO returns, ranging over the different levels of mispricing as described previously in this chapter. We use the QR to estimate the impacts of the variables on each level of mispricing by setting the reference point as the midpoint of the corresponding range. The mid-points for the range of highly overpriced and overpriced IPOs are 0.093 and 0.281 respectively. The mid-point of the range for underpriced IPOs is 0.518. For highly underpriced IPOs it is 0.712 and for extremely underpriced IPOs it is 0.904. Lastly, the mid-point for fairly priced IPOs is 0.4. The QR estimates corresponding to each level of mispricing are reported in columns 3 to 8 of Table 5.5. What is immediately evident is that there are considerable variations in the size, sign and significance of estimates as we move from the highly overpriced IPOs to extremely underpriced IPOs. When looking at the whole sample (using OLS), we find no relationship between issuer size and IPO mispricing; however, this is not true for the overpriced IPOs where smaller firm size is found to increase mispricing. Across the fairly priced and underpriced IPOs, there is no significant relationship between issuer size and mispricing.

The age of the company undertaking the IPO is significantly and positively correlated to overpricing, but is negatively correlated to underpricing. The age of the company has no significant impact on the IPOs that are highly underpriced and extremely underpriced.

Unlike How (1996), who does not find a significant relationship between IPO mispricing and earnings forecasts, the availability of performance forecasts is found to impact the IPOs at the very extremes of mispricing – that is, for the highly overpriced and the highly and extremely underpriced IPOs. For these IPOs, the relationship changes from being significantly positive (for highly overpriced IPOs) to being significantly negative (for highly underpriced and extremely underpriced IPOs). The availability of earnings forecasts does not impact on the less extreme

instances of IPO mispricing, but reduces the level of mispricing for those at both extremes.

Using median QR, we previously found that the level of mispricing is lower for IPOs which raise large amounts of funds. However, examining different levels of the distribution we find that this only applies to IPOs that are only slightly mispriced (overpriced to underpriced IPOs). The magnitude of the coefficient increases with the level of mispricing, suggesting that as the offer size decreases, the magnitude of the mispricing changes from being positive to negative. The amount of funds raised has no discernible impact on the mispricing of IPOs across highly overpriced, highly underpriced and extremely underpriced ranges.

We previously found, when examining the whole sample, that a low issue prices reduce mispricing. This is a finding that applies to all but the highly overpriced and the extremely underpriced IPOs. It is another example of a finding that applies most to the less extreme groups of mispriced IPOs.

It was anticipated that the underwritten issues would be less mispriced, but again we find little evidence for that when examining the IPOs as a whole. Taking a closer look, we find that having an underwriting does result in a lower level of mispricing for underpriced issues. However, being underwritten has no impact on the extent of mispricing for overpriced issues.

Next, we consider the number of risk factors that are disclosed in the prospectus which are considered likely to be positively correlated with the extent of any underpricing. We find this is strongly the case when we apply the OLS regression. But no such relationship is found when we apply the median QR. When we extend the QR analysis to the six ranges of mispricing, we find that greater risk disclosure results in greater underpricing in the case of the extremely underpriced IPOs.

Finally, market euphoria is associated with greater underpricing. Indeed, we find this to be the case for all except for the most highly overpriced issues. The sign on this variable is positive for the other five groups, which means that the IPOs issued during periods when the overall market is performing particularly well will be more underpriced/less overpriced. The coefficient of market performance is consistent for the milder levels of mispricing but is considerably higher for the highly

underpriced and the extremely underpriced IPOs, suggesting that the better the market performance, the higher the mispricing.

We now summarise the results of the independent variables at various levels of mispricing. We find two interesting observations from Table 5.5. First, the sets of variables that significantly impact on mispricing tend to vary across the levels of mispricing. Second, the independent variables have more significant relationships with the milder levels of mispricing (overpriced, fairly priced and underpriced IPOs) compared to those on the tails (highly overpriced, highly underpriced and extremely underpriced IPOs).

The results show that larger and older firms that provide earnings forecasts are significantly more likely to have highly overpriced IPOs. For the IPOs that are slightly mispriced (or fairly priced), we find that the factors that significantly impact mispricing are firm age, offer size, offer price, underwriter involvement and recent market performance.

Now turning to the highly underpriced IPOs, we find that non-provision of earnings forecast, higher offer price (reflected by the increase in the magnitude of $InvOP_i$), lack of underwriter involvement and positive market performance increase mispricing. Lastly, extremely underpriced IPOs are significantly impacted by lack of earnings forecast, no involvement of an underwriter, highly euphoric market and higher number of risk factors reported in the prospectus. This suggests that investors who buy underpriced and extremely underpriced IPOs are compensated for the risk they take in investing in those IPOs (Beatty & Ritter, 1986; Ljungqvist, 2007). On the other hand, company characteristics, offer characteristics, issue certification and market sentiment is positively related with IPOs at milder levels of mispricing (Dimovski & Brooks 2004; 2008; Gygax & Ong, 2011).

Overall, our results show that independent variables impact differently across different levels of mispricing. Table 5.6 presents the F-statistics of the equality of slope parameters across the levels of mispricing that we examined. The test reveals the differences between the slope estimates of the various levels of the mispricing distribution. These differences are significant at the 1% level. These tests reveal differences between the IPOs in two extreme regions, the highly overpriced and the extremely underpriced IPOs. This confirms the impacts that independent variables

have on various levels of mispricing are significantly different across the mispricing distribution, and supports our use of the QR to explore those differences.

Table 5.6: Tests of the equality of slope estimates across quantiles

Levels of mispricing	Quantiles	Estimate	p-value
Highly overpriced vs extremely underpriced	0.093 vs 0.904	28.42	0.000***
Overpriced vs highly underpriced	0.281 vs 0.712	6.41	0.000***
Fairly priced vs underpriced	0.40 vs 0.518	1.41	0.073*
All levels of mispricing	0.093 vs 0.281 vs 0.40 vs 0.518 vs 0.712 vs 0.904	21.25	0.000***

1. The table shows the F-statistics of the equality of slope estimates across the selected quantiles representing the levels of the first day returns.
2. Coefficients significant at the levels of 1%, 5% and 10% are marked by ***, ** and * respectively.

5.6 Conclusion

The aim of this chapter is to examine the mispricing of IPOs in the Australian market. Using a sample of Australian IPOs issued during the period from 1995 to 2013, we find an average mispricing of 25.51%, consistent with previous studies on Australian IPOs. However, we find that the distributions of these first day returns are heavily skewed to the right. This fact is substantially ignored in previous studies. Considering the asymmetry of the distribution, we argue that the mean overstates the mispricing of IPOs. We argue that the median of first day returns provides a better measure of the extent of mispricing. In the case of Australia this reduces the estimate of the extent of mispricing from 25.51% (mean) to 10.00% (median). We find the mispricing distribution is skewed to the right with 37.70% of the IPOs being overpriced. To capture the characteristics of the IPOs across the varying magnitudes of mispricing, we divided the first day returns into various levels of mispricing: highly overpriced, overpriced, fairly priced, underpriced, highly underpriced and extremely underpriced.

Our OLS analysis reveals that firm age and the release of earnings forecasts tend to decrease the extent of mispricing, whereas higher number of risk factors and positive market performance increase mispricing. On the other hand, using the median QR we find that younger business entities undertaking an IPO, smaller offer size, higher offer price and no the involvement of an underwriter, increase mispricing. In addition, positive market performance is also found to be positively related to mispricing.

The comparison of OLS with median QR shows that using the median as a measure of central tendency provides a more accurate and detailed understanding of the impact that the independent variables have on the mispricing. The results show that the IPOs are more mispriced when investors find themselves at an information disadvantage. The examination of the six levels of mispricing using the QR approach shows that the impacts of the independent variables vary across the levels of mispricing. The QR estimates show that the highly overpriced IPOs are significantly impacted by firm size, firm age and provision of earnings forecast. Further, we find that firm age, offer size, offer price and involving a financial institution as an underwriter reduce the mispricing of the three levels of the underpriced IPOs. However, the highly underpriced and extremely underpriced IPOs are associated with risky firms that do not provide earnings forecasts, involve an underwriter and report a higher number of risk factors. Lastly, we find that most of the firms issue their IPOs during periods of higher market performance. We do not find any significant relationship between realised volatility and mispricing.

Chapter 6: Mispricing in China

6.1 Introduction

In this chapter we examine the mispricing of 2199 Chinese IPOs that are listed on the Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange (SZSE) from 1995 to 2013.

The SSE and the SZSE are the fourth- and eighth-largest stock markets in the world[23] respectively and are categorised as emerging markets.[24] The Chinese stock exchanges are still not completely open to foreign investors and are tightly regulated and administered by the China Securities Regulatory Commission (CSRC). The Chinese market has been subject to regulatory restrictions specifically in regards to the supply and pricing of IPOs which, over time, have evolved to be more market oriented. Initially, the government had two ways of intervening in the IPO market. The first way was restricting the number of IPOs, which was a common practice from 1990 to 2000. As a result the IPO market was dominated by state-owned firms going public. These firms struggled to compete with the private firms in the market. In response to the competition faced by the state-owned firms, the Chinese government imposed IPO quotas for provinces and municipalities to control the number of firms going public. The restricted supply of IPOs in a capital market lacking sufficient investment opportunities gave rise to huge excess demand and resulted in high first day returns (Gao, 2010). In the early 2000s, the government removed IPO quotas by moving to the standard process of registration of the IPOs, allowing companies to make their own decisions to go public.

The second way in which the government intervened was to regulate the IPO pricing mechanism. The pricing mechanism has two broad regimes: fixed pricing and book building. The reforms in the pricing mechanism that took place over time are sub-categories of the fixed price and book building pricing systems. From 1990 to 1995, most IPOs were sold by way of a fixed price, with the CSRC determining the number of shares issued, the offer price and the PE ratio. From 1996 to mid-1999, a relatively fixed price-to-earnings (PE) ratio mechanism was introduced in

[23] World Federation of Exchanges Ranking.
[24] FTSE Global Equity Market Index.

which after-tax earnings per share and relative earnings were used to determine the IPO price. The PE was determined by the CSRC which usually fixed it at between 12 and 15. From July 1999 to mid-2002, the CSRC switched to an auction system where the offer price was determined by investors using an online bidding process. The auction mechanism was adopted to let the market completely set the price. However, the change in the system did not reduce the magnitude of IPO mispricing. Instead mispricing was as high as 1365%, with average returns for the period between mid-1999 to mid-2000 being 153.36%. The change in pricing mechanism led to huge losses in stock prices in later trading. Therefore, for July 2000 to 2004, the pricing mechanism reverted to a fixed PE mechanism with the offer price PE ratio being less than 20. In December 2004, the regulations changed again, and the book-building system of price setting was adopted on 1 January 2005. This change in the pricing regime was a major shift, with market forces, rather than the government, now being the major force in determining the issue price. Our results show that the adoption of the book-building pricing mechanism has significantly reduced the average mispricing to 61.2% from 2005 to 2013, compared to 169.7% for the period from 1995 to 2004.

6.2 Studies on China

Data on the mispricing of Chinese IPOs is summarised in Table 6.1. What is immediately evident is the exceptionally high levels of mispricing, that are higher than those in other emerging markets (see Table 1.1). Mok and Hui (1998) examine 101 IPOs listed in the Shanghai Stock Exchange from 1990 to 1993. These IPOs were mispriced by 434.90%. Later studies continue to report high levels of mispricing in Chinese IPOs, with a decline in the magnitude of mispricing over the years, ranging from 948.59% (Su & Fleisher, 1999) to 50.17% (Cao et al. (2013).

The traditional mispricing theories that are known to explain the mispricing of the IPOs more generally do not adequately explain the mispricing of Chinese IPOs, except for ex-ante uncertainty being the key driver of the mispricing. Yu and Tse (2006) examine the mispricing of 343 Chinese IPOs using the winners curse model, the ex-ante uncertainty theory and the signalling model. They find strong support for ex-ante uncertainty being the main reason for the high levels of mispricing. The factors that increase uncertainty are firm age and offer size.

Further studies examining the mispricing of Chinese IPOs identify various firm-level attributes and institutional factors that explain the high levels of mispricing. The firm-level attributes that are found to increase the level of mispricing are firm size (Chen et al., 2004), firm age (Tian, 2011), retained ownership (Su & Fleisher, 1999), provision of higher earnings forecast (Chen et al., 2004), smaller offer size (Mok & Hui, 1998; Yu & Tse, 2006), offer price (Chan et al., 2004; Chang et al., 2008) and recent market performance (Cheung et al., 2009; Chiou et al., 2010). The factors that are found to reduce mispricing are earnings forecast (Kao, Wu & Yang, 2009), offer price (Guo & Brooks, 2008) and involvement of a VC (Cao et al., 2013). When going public, Chinese IPOs often experience huge time lapses between the time an IPO is offered and when it is listed on the stock exchange. This delay in listing is also found to increase ex-ante uncertainty and the resulting mispricing (Tian, 2011).

Table 6.1: Mispricing of Chinese IPOs

Study	Period	N	Mean (%)	Median (%)
Mok & Hui (1998)	1990 – 1993	101	434.90	-
Su & Fleisher (1999)	1987 – 1995	308	948.59	231.25
Chen et al. (2004)	1992 – 1997	701	298.00	145.00
Chan, Wang & Wei (2004)	1993 – 1998	570	177.70	-
Wang (2005)	1994 – 1999	747	271.90	123.90
Yu & Tse (2006)	1995 – 1998	343	123.59	111.23
Guo & Brooks (2008)	1984 – 2005	1393	378.41	119.37
Cheung et al. (2009)	1992 – 2006	1191	133.61	107.12
Gao (2010)	2006 – 2008	217	157.00	-
Chiou, Li, Cheng & Chang (2010)	1995 – 2007	1080	118.70	103.50
Lee et al. (2010)	1993 – 2005	1249	144.42	108.16
Tian (2011)	1992 – 2004	1377	247.00	122.00
Cao et al. (2013)	2009 – 2010	153	50.17	-
Tian & Zhang (2014)	1993 – 2010	1970	181.60	98.11

1. The table summarises the mispricing evidence from Chinese IPO studies.

It is a common finding in IPOs studies that having underwriters impacts the level of mispricing (Dimovski & Brooks, 2004; Dolvin & Jordan, 2008). However, studies examining mispricing in China show little support in favour of this impact. Tian and Zhang (2014) study the relationship between IPO mispricing and underwriter reputation and argue that, given the Chinese market characteristics where the government has an active role in IPOs pricing, underwriter reputation does not have any explanatory power.

Cheung et al. (2009) study the impact of a changing pricing mechanism on the initial returns of 1191 IPOs that were mispriced by 133.61%. They find that high mispricing in Chinese IPOs is caused by the fixed price mechanism and the firms going public during periods when the market is enjoying positive performance. However, they observe that as the pricing mechanism changed to the book building method, the magnitude of the initial returns started decreasing. Similarly, Chiou et al. (2010) and Lee et al. (2010) also find a decline in the level of mispricing when the book building method was adopted.

A common finding in the other markets is the skewness of the mispricing distribution. The same is true for Chinese IPOs. Su and Fleisher (1999) report 948.59% (231.25%) mean (median) mispricing in a sample of 308 IPOs issued between 1987 and 1995. Guo and Brooks (2008) report a sample of 1393 IPOs issued between 1984 and 2005 has mean (median) mispricing of 378.41% (119.37%). Tian and Zhang (2014) report mean and median mispricing of 181.60% and 98.77% respectively in a sample of 1970 IPOs issued from 1993 to 2010. Some recent studies on Chinese IPOs have attempted to address this issue. Lee et al. (2010) divide the distribution of the first day returns into three equal categories, referred to as low initial returns (quantile 0.1, 0.2 and 0.3), medium initial returns (quantile 0.4, 0.5 and 0.6) and high initial returns (quantile 0.7, 0.8 and 0.9). Using a QR approach, they show that the offer price is negatively correlated with the level of mispricing. That is, the lower the offer price, the higher the underpricing. Higher levels of mispricing are associated with IPOs that have longer delays between the IPO date and the listing date. They also find that firms that go public during periods of positive market performance are more mispriced. Tian (2011) studies 1377 IPOs issued between 1992 and 2004 with mean (median) mispricing of 247% (122%). Tian reports that 34% of the sample IPOs were overpriced, with mean returns of -38%. Using the bootstrap empirical analysis method to overcome the issue of non-normality in the sample, Tian shows that the factors that cause mispricing in Chinese IPOs are: smaller size of issuer, longer trading history, restrictions on pricing mechanism and longer delays in IPO listing.

In short, the evidence to date from studies examining the first day returns of the Chinese IPOs suggests that the Chinese IPOs typically have higher returns than those in other markets. They find that the high initial returns are caused by ex-ante

uncertainty, regulatory interventions in the pricing mechanism, and market momentum, which are driven by the institutional characteristics of the Chinese IPOs market.

6.3 Method

The base model for the study is presented in Equation (3.3). The empirical model to examine the mispricing of the Chinese IPOs is presented in Equation (6.1). Since the focus of this chapter is on examining the mispricing of Chinese IPOs, we use, X_{it}^{j}, which denotes the firm-level explanatory variables (discussed in Section 3.2.2) and year dummies, and X_{it}^{m}, to control for time effects.

$$\begin{aligned} log\ RR_{i,t} = \alpha &+\beta_1 logAssets_i +\beta_2 logAge_i +\beta_3 EPS_i +\beta_4 RetOwn_i +\beta_5 logOS_i \\ &+\beta_6 IM_i +\beta_7 InvOP_i +\beta_8 VC_i +\beta_9 UMS_i +\beta_{10} RF_i +\beta_{11} MP30_i + \\ &\beta_{12} Exchange_i +\beta_{13} logLagDays_i +\beta_{14} RelVol_i +\Sigma Year_i+\varepsilon_{i,t} \end{aligned} \quad (6.1)$$

The dependent variable is the logarithm of one plus first day returns ($RR_{i,t}$). The first day returns are measured through a standard returns calculation procedure using Equation (3.1). In addition to the independent variables used in the previous chapters, we use two more variables. One is $Exchange_i$ which is a dummy variable with a value of 0 if the IPO is listed on the SSE and 1 if the IPO is listed on the SZSE. The other is $logLagDays_i$ which we use to capture the number of days between the issue and the listing of the IPO. The definitions of the independent variables used in this chapter and the expected signs of their relationships with the first day IPO returns are summarised in Table 6.2. The expected signs are based on the relationships reported in the previous studies.

We also examine the impact of the change in pricing regime that took place in January 2005. To do this, we multiply all the variables in Equation (6.1) with a dummy variable *Regime*, which takes the value of 0 if the IPO is issued before 2005 and 1 otherwise. The functional form of this method is given in Equation (6.2). The coefficient of variable $X_{i,\,(pre)}$ is the coefficient of the explanatory variables before the regime shift. The coefficient $X_{i,\,(diff)}$ reflects the difference between the coefficients of the independent variables before and after the regime shift. In order to obtain the coefficient of the independent variables after the regime shift ($X_{i,\,(post)}$) we add the coefficients of $X_{i,\,(pre)}$ and $X_{i,\,(diff)}$. The significance of $X_{i,\,(post)}$ is determined by using the Wald test.

$$logRR_{i,t} = \alpha + \sum_{j=1}^{J} \beta_j X_{it}^{j} + \sum_{j=1}^{J} \beta_l Regime.X_{it}^{j} + \sum Year_i + \varepsilon_i \qquad (6.2)$$

Table 6.2: Definitions of independent variables

Variable	Definitions	Expected Sign
$logAssets_i$	Logarithm of one plus pre-IPO total assets.	-
$logAge_i$	Logarithm of the firm's age in years calculated from the difference of the foundation year and the time of the IPO.	+
EPS_i	Earnings forecast provided in the IPO prospectus.	-
$RetOwn_i$	Calculated as one minus the number of shares issued / total number of shares outstanding.	-
$logOS_i$	Logarithm of offer size measured from the final offer price multiplied by the number of shares offered.	-
IM_i	A dummy variable with the value of 1 if the IPO is fixed price offer and 0 for book building offer.	+
$InvOP_i$	One divided by final offer price per share.	-
UMS_i	Underwriter's market share calculated through the capital raised by the underwriter in a year, divided by capital raised by all the IPOs in that year.	-
VC_i	A dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise.	-
RF_i	The number of risk factors reported in the IPO prospectus	+
$MP30_i$	pre-IPO 30-day performance of the market index where the stock is listed.	+
$logLagDays_i$	Logarithm of one plus no. of days between IPO date and listing date.	+
$Exchange_i$	A dummy variable with value of 0 for the SSE and 1 for the SZSE.	+/-
$RelVol_i$	Realised volatility of 30-day pre-IPO is calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$	+

1. The table summarises the expected signs of the relationships between the independent variables and the first day IPO returns.

6.4 Sample characteristics

6.4.1 Descriptive statistics

Descriptive statistics for the variables for the whole sample are reported in Table 6.3. The average mispricing of the sample IPOs is 112.10% and the median is 71.40%. The skewness of the mispricing distribution is 8.85. This suggests that the distribution of the first day returns is heavily skewed to the right with 6.27% (138 IPOs) of the sample IPOs being overpriced and only 31.83% (700 IPOs) having above average returns. The average age of the Chinese sample IPOs is approximately 6.10 years which is a year higher than the Australian sample and also higher than the 3.06 years previously reported for China (e.g. Yu & Tse, 2006) but much less than the 17.70 years reported for international IPOs by Engelen and

van Essen (2010). The total money raised by the IPOs over our sample period was CNY 2,288.248 billion with an average offer size of CNY 1,040.586 million.

Table 6.3: Descriptive statistics of the whole sample

Variables	Mean	St. Dev	Median	Skewness
First day returns (%)	112.10%	212.70%	71.40%	8.85
Offer price (CNY)	15.15	14.59	9.60	3.53
Assets (CNY M.)	11,234.24	194,028.30	263.78	22.87
Age (years)	6.10	9.77	3.82	7.05
EPS (CNY)	0.65	0.85	0.34	2.49
Retained Ownership (%)	72.90%	7.60%	74.80%	-0.67
Offer Size (CNY M.)	1,040.58	3,861.91	420	11.9
Issue Method	0.45	0.49	0.00	0.19
Inverse offer price	0.13	0.12	0.10	4.01
Underwriter Market Share	0.04	0.05	0.02	3.29
Venture Capitalist	0.17	0.38	0.00	1.70
No. of Risk Factors	28.3	8.71	28.00	0.20
$MarketPerformance_{t-30}$ (%)	1.80%	11.90%	0.39%	0.85
Exchange	0.64	0.48	1.00	-0.59
Lag Days (Days)	54.36	241.88	14.00	7.68
Realised Volatility $_{t-30}$ (%)	27.50%	12.8%	23.70%	1.20
No. of IPOs	2,199			

1. The names and the listing dates of 2235 Chinese A-Shares IPOs, listed at the SSE and the SZSE, issued during the period from 1995 to 2013 were identified using the Morningstar Global Database. The offer prices of the IPOs and all the independent variables except for market performance were obtained from the IPO prospectuses available on Thomson One Banker, the SSE and the SZSE websites. The daily adjusted trading prices of the stocks included in our sample and the composite indices of the market where the stock is listed, which are used as a benchmark for market performance, were collected from DataStream. The final sample excluded firms with unavailable prospectuses, unavailable historical prices, close-end funds, and issues without a public offer component, leaving the final sample size of 2199 IPOs.
2. The table summarises the descriptive statistics of the dependent and independent variables used in the study.
3. The first day returns are calculated as (First day closing price – Offer price)/Offer price. Assets are pre-IPO total assets. Age is the firm's age in years calculated at the time of IPO from date of incorporation. EPS Earnings forecasts are provided in the IPO prospectuses. Retained Ownership is one minus the number of shares issued over total number of shares outstanding. Offer Size is measured as the final offer price multiplied by the number of shares offered. Issue Method is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. Inverse offer price is one divided by final offer price per share. UMS is the underwriter's market share calculated through the capital raised by the underwriter in a year divided by capital raised by all the IPOs in that year. Venture Capitalist is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. No. of Risk Factors measures the risks reported in the IPO prospectus. $MarketPerformance_{t-30}$ is the pre-IPO 30-day performance of the market index where the stock is listed. Exchange is a dummy variable with value of 0 if the IPO is listed in the SSE and 1 for the SZSE. Lag Days are the no. of days between offering date and listing date. Realised Volatility $_{t-30}$ is the 30-day pre-IPO volatility of market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.

The issuing companies retained 72.90% of the ownership on average, with those companies with the highest proportion of retained ownership being in the financial sector. The companies with the lowest proportion of retained ownership are from the consumer goods sector. A little less than half of our sample IPOs (45.20%) were priced using the book building method. The sample IPOs are listed on either of the two exchanges of mainland China – 35.80% on the Shanghai Stock Exchange and 64.20% on the Shenzhen Stock Exchange.

6.4.2 Mispricing in the SSE and the SZSE

Table 6.4 reports the descriptive statistics of the key variables of the IPOs listed in the SSE and the SZSE. There are some observable differences between the IPO characteristics of the two stock exchanges. The IPOs listed on the SSE have a mean (median) mispricing of 125.20% (95.10%) whereas the mean (median) mispricing of the IPOs listed in the SZSE is 104.80% (56.13%). In contrast to previous studies (e.g. Chang, Chen, Chi & Young, 2008; Chi & Padgett, 2005) we find the mean mispricings of the IPOs of the two exchanges to be significantly different. Furthermore, the IPOs listed in the SSE have larger pre-IPO assets and offer sizes, are younger, provide less earnings forecasts and are sold at lower prices than the IPOs listed in the SZSE. The characteristics of the firms listed on the SSE reflect higher risk characteristics and are more mispriced. The differences in the means are significant except for the number of risk factors, pre-IPO market performance and lag days.

6.4.3 Levels of mispricing

The differences between the means and medians and the skewness of the first day returns reported in Table 6.3 show a significantly skewed distribution. This is further confirmed by the Shapiro-Wilk test which rejects the null hypothesis that the first day returns are normally distributed. The right-skewed distribution is clearly observable from the distribution plot in Figure 6.1. The difference between the mean and median levels of mispricing is driven by approximately 31% of the IPOs being on the right tail of the mispricing distribution. Those IPOs are on average mispriced by 263.50% and maximum returns go as high as 3875%. In order to further investigate the variability of the mispricing across the sample, the distribution of Chinese IPOs' returns is divided into three categories: IPOs with negative returns, IPOs with close to zero returns and IPOs with positive returns. There are 138 IPOs with negative returns which are called overpriced IPOs. There are 2010 IPOs with positive returns which are divided into three equal subcategories: underpriced IPOs, highly underpriced IPOs and extremely underpriced IPOs. Finally, there are 51 IPOs with close to zero returns (i.e. ranging from 0.0001% to +0.0001%), which we refer to as fairly priced IPOs. The average mispricing of these sub-ranges and the corresponding means of the independent variables are reported in Table 6.5.

Table 6.4: Descriptive statistics by stock exchange

Variables	Shanghai Stock Exchange (SSE)				Shenzhen Stock Exchange (SZSE)				SSE – SZSE	
	Mean	**SD**	**Median**	**Skewness**	**Mean**	**SD**	**Median**	**Skewness**	**Mean diff.**	**t-stats**
First day returns (%)	125.20%	158.90%	95.10%	5.47	104.80%	237.20%	56.10%	9.09	20.40%	2.40**
Assets (CNY M.)	30,480.57	323,344.70	320.89	13.64	484.16	1,479.23	246.87	17.13	29,996.4	2.60***
Age (years)	4.11	7.75	2.15	8.99	7.21	10.57	5.78	6.55	-3.10	-7.86***
EPS (CNY)	0.60	0.85	0.28	1.84	0.69	0.85	0.41	2.87	-0.09	-2.34**
Retained Ownership (%)	71.10%	9.60%	70.90%	-0.18	73.80%	6.10%	75.00%	-0.96	-2.70%	-7.15***
Offer Size (CNY M.)	1,848.57	6,334.08	369.32	7.18	589.35	536.00	451.20	3.21	665.24	5.56***
Issue Method	0.76	0.42	1.00	-1.26	0.27	0.45	0.00	0.99	0.49	25.46***
Inverse offer price	0.17	0.12	0.15	3.71	0.10	0.12	0.06	4.95	0.07	13.43***
Underwriter Market Share	0.05	0.06	0.03	2.94	0.03	0.03	0.02	1.87	0.02	9.53***
Venture Capitalist	0.15	0.35	0.00	1.97	0.19	0.39	0.00	1.57	-0.04	-2.52**
No. of Risk Factors	28.20	8.81	28.00	0.18	28.32	8.65	28.00	0.21	-0.12	-0.33
$MarketPerformance_{t-30}$ (%)	1.40%	9.00%	0.01%	0.87	2.10%	13.00%	0.6%	0.79	-0.07%	-1.41
Lag Days (Days)	65.26	276.58	17.00	7.74	48.27	220.01	13.00	7.31	16.99	1.48
Realised Volatility	24.10%	12.89%	19.61%	1.29	29.30%	12.44%	25.47%	1.30	-5.20%	-87.80***
No. of IPOs	788				1,411					

1. The data sources are consistent with Table 6.3.
2. The table summarises the descriptive statistics of the dependent and independent variables of the IPOs in the relevant exchange.
3. The first day returns are calculated as (First day closing price – Offer price)/Offer price. Assets are pre-IPO total assets. Age is the firm's age in years calculated at the time of IPO from date of incorporation. EPS is the earnings forecasts provided in the IPO prospectus. Retained Ownership is one minus the number of shares issued over total number of shares outstanding. Offer Size is measured as the final offer price multiplied by the number of shares offered. Issue Method is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. Inverse offer price is one divided by the final offer price per share. UMS is the underwriter's market share calculated through the capital raised by the underwriter in a year divided by capital raised by all the IPOs in that year. Venture Capitalist is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. No. of Risk Factors measures the risks reported in the IPO prospectus. $MarketPerformance_{t-30}$ is the pre-IPO 30-day performance of the market index where the stock is listed. Exchange is a dummy variable with a value of 0 if the IPO is listed in the SSE and 1 for the SZSE. Lag Days are the no. of days between the IPO date and the listing date. Realised Volatility $_{t-30}$ is the 30-day pre-IPO volatility of the market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.
4. Mean differences significant at the levels of 1%, 5% and 10% are marked by ***, ** and * respectively.

Table 6.5: Variable means by the extent of mispricing

Variables	Overpriced	Fairly Priced	Underpriced	Highly underpriced	Extremely underpriced
	(0 – 0.063)	**(0.063 – 0.086)**	**(0.086 – 0.391)**	**(0.391 – 0.695)**	**(0.695 – 1)**
First day returns (%)	-9.10%	0.00%	25.62%	81.06%	263.50%
Assets ($M.)	930.05	105,186.14	22,534.23	4,626.27	1,500.83
Age (years)	9.17	7.41	7.58	5.57	4.42
EPS (CNY)	0.52	0.45	0.56	0.66	0.78
Retained Ownership (%)	76.30%	76.00%	74.58%	72.30%	70.74%
Offer Size ($M.)	1,274.58	2,640.80	1,497.70	992.81	460.02
Issue Method	0.05	0.12	0.22	0.52	0.72
Inverse Offer Price	0.05	0.07	0.08	0.13	0.19
Underwriter Market Share	0.04	0.05	0.04	0.04	0.03
Venture Capitalist	0.26	0.22	0.20	0.17	0.13
No. of Risk Factors	28.52	27.76	28.08	28.41	28.32
Market Performance $_{t-30}$ (%)	-6.80%	-4.60%	-0.80%	2.40%	6.00%
Exchange	0.77	0.86	0.75	0.58	0.54
Lag Days (Days)	53.04	14.21	15.42	24.17	126.93
Realised Volatility $_{t-30}$ (%)	21.70%	24.50%	24.80%	28.10%	30.80%
No. of IPOs	138	51	670	670	670

1. The data sources are consistent with Table 6.3.

2. The table breaks down the levels of the first day returns based on the magnitude of mispricing, where 0 to 0.063 refer to overpriced IPOs, 0.063 to 0.086 refer to fairly priced IPOs and 0.086 to 0.391, 0.391 to 0.695 and 0.695 to 1 refer to underpriced, highly underpriced and extremely underpriced IPOs respectively.

3. The first day returns are calculated as (First day closing price – Offer price)/Offer price. Assets are pre-IPO total assets. Age is the firm's age in years calculated at the time of IPO from date of incorporation. EPS Earnings forecasts are provided in the IPO prospectuses. Retained Ownership is one minus the number of shares issued over total number of shares outstanding. Offer Size is measured as the final offer price multiplied by the number of shares offered. Issue Method is dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. Inverse offer price is one divided by final offer price per share. UMS is the underwriter's market share calculated through the capital raised by the underwriter in a year divided by capital raised by all the IPOs in that year. Venture Capitalist is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. No. of Risk Factors measures the risks reported in the IPO prospectus. $MarketPerformance_{t-30}$ is the pre-IPO 30-day performance of the market index where the stock is listed. Lag Days are the no. of days between IPO date and listing date. Exchange is a dummy variable with a value of 0 if the IPO is listed in the SSE and 1 for the SZSE. Lag Days are the number of days between IPO date and listing date. $Realised\ Volatility_{t-30}$ is the 30-day pre-IPO volatility of market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.

Figure 6.1: Distribution plot showing Chinese IPO mispricing

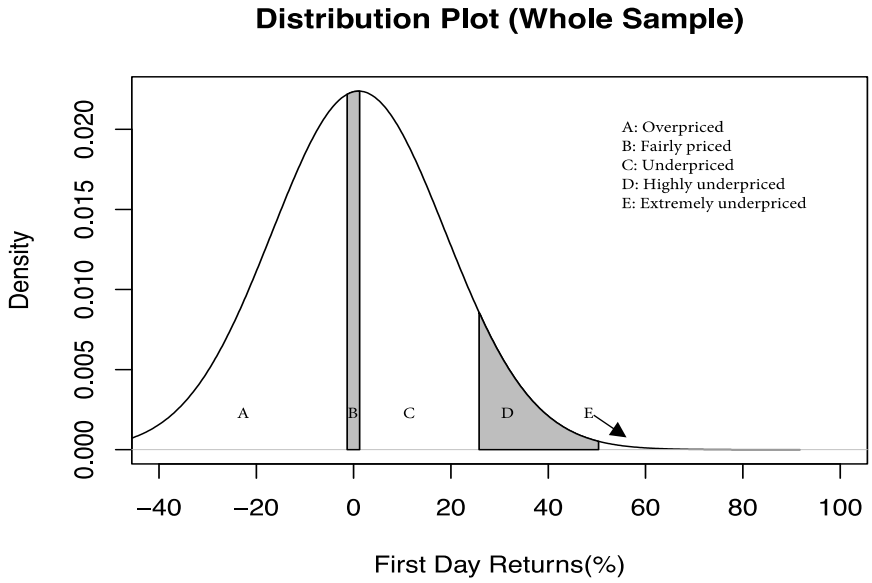
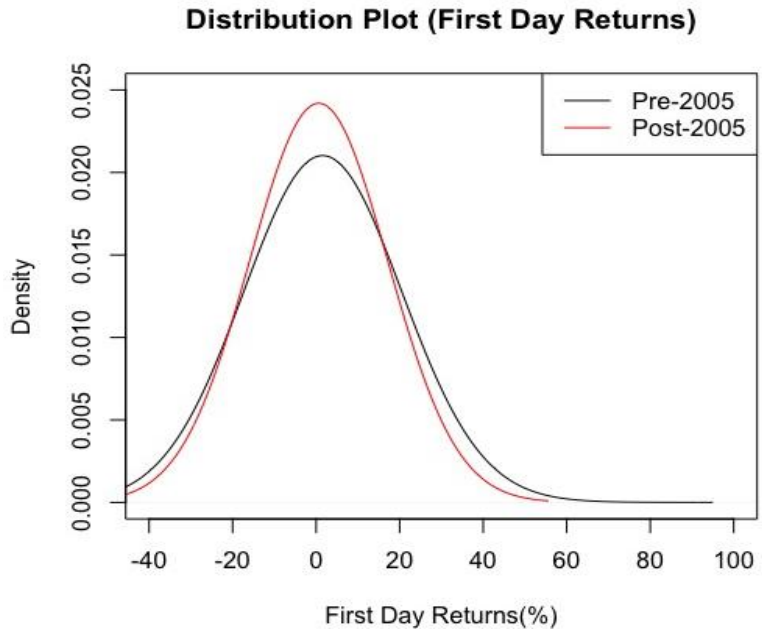


Table 6.5 shows an observable non-uniformity in the mispricing across the levels of mispricing. Examination of the characteristics of the dependent and the independent variables shows that the IPOs within each level of mispricing have varying characteristics. The overpriced IPOs are small companies that are older, provide lower earnings forecasts and retain larger proportions of shares. Additional characteristics include they involve larger offer sizes, are mostly book built, are listed mostly in the SZSE and go public in periods of lower market performance and volatility. On the other hand, extreme cases of underpricing are observed in IPOs that are younger and smaller companies with smaller offer sizes and offer prices that provide larger earnings forecasts and are mostly fixed price IPOs. These companies are mostly listed on the SSE and go public during periods of high market performance and volatility, with large delays between their IPO dates and listing dates. The fairly priced IPOs are firms that are old, have the largest firm size and offer size, with the smallest delays between the IPO and the listing date. Lastly, it is important to mention that the factors that do not vary across the levels of mispricing are: underwriter's market share, which according to Tian and Zhang (2014) does not have a significant role to play in pricing of the IPOs, and the number of risk factors reported in the prospectus.

Figure 6.2: Distribution plot for IPO mispricing for two periods



6.4.4 Change in pricing mechanism

A key development peculiar to the Chinese market is the continuous change in the IPO pricing mechanism over time. In the beginning IPOs were priced using variants of the fixed price method, with high involvement of the government in setting the final offer price. This price setting mechanism is considered to be a major factor in the higher underpricing of Chinese IPOs (Tian & Zhang, 2014). The pricing mechanism gradually changed to the market-oriented method of book building which was formally adopted in January 2005. Table 6.6 reports the descriptive statistics of the key variables before (IPOs from 1995 to 2004) and after (IPOs from 2005 to 2013) the shift in pricing mechanism. One observation that is immediately evident is a significant shift in the size of mispricing from 167.7% to 61.2% and also a decline in the skewness of the returns distribution. These features are clearly observable by comparing the distribution plots in Figure 6.2. Further, there is also a change in the characteristics of the firms going public when the book building method of pricing was adopted. The companies that went public pre-2005 had an average size of CNY 951.61 million, were 3.65 years old and had an average offer size of CNY 431.84 million. In contrast, firms going public after 2005 were larger (CNY 20350.81 million), older (8.27 years) and had larger offer sizes (CNY 1578.92 million). After the post-regime shift, companies provided lower earnings forecasts (0.51), sold IPOs at higher price, had more involvement of venture capitalists and reduced time delays between the offer date and the listing date. The

Table 6.6: Descriptive statistics: pre and post change in pricing regime

Variables	(Pre-2005 IPOs)				(Post-2005 IPOs)				post – pre regime period	
	Mean	**SD**	**Median**	**Skewness**	**Mean**	**SD**	**Median**	**Skewness**	**Mean diff.**	**t-stats**
First day returns (%)	169.70%	288.40%	112.80%	6.96	61.20%	79.00%	37.00%	2.57	-108.50%	-11.71***
Assets (CNY M.)	951.61	6,552.16	244.59	17.90	20,350.81	266,154.76	283.95	16.64	19,399.00	2.48**
Age (years)	3.65	11.81	1.03	7.35	8.27	6.83	7.66	7.22	4.61	11.01***
EPS (CNY)	0.82	1.03	0.29	1.14	0.51	0.62	0.40	6.31	-0.31	-8.36***
Retained Ownership (%)	69.90%	8.50%	70.20%	0.06	75.00%	6.00%	75.00%	-1.55	0.05	17.72***
Offer Size (CNY M.)	431.84	829.12	280.50	9.68	1,578.92	5,185.45	600.00	8.97	1,147.1	7.45***
Issue Method	0.95	0.20	1.00	-4.47	0.01	0.08	0.00	11.97	-0.94	-139.56***
Inverse offer price	0.19	0.14	0.16	4.102	0.07	0.06	0.05	2.88	-0.119	-25.024***
Underwriter Market Share	0.05	0.04	0.03	3.03	0.04	0.05	0.02	3.60	-0.01	-5.26***
Venture Capitalist	0.11	0.31	0.00	2.55	0.24	0.43	0.00	1.23	0.13	8.35***
No. of Risk Factors	27.98	8.91	28.00	0.31	28.54	8.51	28.00	0.10	0.56	1.51
$MarketPerformance_{t-30}$(%)	1.65%	14.00%	-0.03%	0.82	0.82%	8.00%	0.00%	9.00%	-0.83%	-4.03***
Exchange	0.38	0.48	0.00	0.49	0.87	0.33	1.00	-2.23	0.49	27.29***
Lag Days (days)	102.20	346.92	21.00	5.14	12.05	7.24	11.00	19.98	-90.15	-8.34***
$RealisedVolatility_{t-30}$(%)	28.60%	15.90%	22.40%	0.92	26.40%	9.00%	23.90%	1.25	-2.20%	-3.91***
No. of IPOs	1,032				1,167					

1. The data sources are consistent with Table 6.3.
2. The table summarises descriptive statistics of the sample IPOs for the pre-regime change period i.e. 1995–2004 and post-regime period i.e. 2005–2013.
3. The first day returns are calculated as (First day closing price – Offer price)/Offer price. Assets are pre-IPO total assets. Age is the firm's age in years calculated at the time of IPO from date of incorporation. EPS Earnings forecasts are provided in the IPO prospectuses. Retained Ownership is one minus the number of shares issued over total number of shares outstanding. Offer Size is measured as the final offer price multiplied by the number of shares offered. Issue Method is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offered. Inverse offer price is one divided by final offer price per share. Underwriter Market Share is the underwriter's market share calculated through the capital raised by the underwriter in a year divided by capital raised by all the IPOs in that year. Venture Capitalist is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. No. of Risk Factors measures the risks reported in the IPO prospectus. $MarketPerformance_{t-30}$ is the pre-IPO 30-day performance of the market index where the stock is listed. Lag Days are the no. of days between IPO date and listing date. Exchange is a dummy variable with a value of 0 if the IPO is listed in the SSE and 1 for the SZSE. Lag Days are the no. of days between IPO date and listing date. $RealisedVolatility_{t-30}$ is the 30-day pre-IPO volatility of the market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.
4. Mean differences significant at the levels of 1%, 5% and 10% are marked by ***, ** and * respectively.

tests for the mean differences of the independent variables reveal significant differences between the IPO characteristics before and after the regime shift, with the exception of the number of risk factors.

6.5 Results and findings

6.5.1 OLS and median regression estimates

Table 6.7 reports the regression coefficients of Equation (6.1). The first column reports OLS regression coefficients. The significant variables are age (+), EPS forecast in the prospectus (+), offer size (-), offer price (+), risk factors reported in the prospectus (+), market performance (+), stock exchange (-), delay in IPO date and the listing date (+) and realised volatility (+). Column 2 reports median QR results which show a change in the magnitude of the coefficients of the independent variables compared to the OLS. Eight out of nine variables under the OLS regression remain significant when we use median regression: age (+), earnings per share forecast (+), offer size (-), offer price (-), market performance (+), exchange (-), lag days (+) and realised volatility (+). The variable that has a significant impact under the OLS model but is not found to be significant under the median QR is the number of risk factors reported in the prospectus.

The results are consistent with the information asymmetry hypothesis (Beatty & Ritter, 1986; Yu & Tse, 2006) and previous studies. The mispricing is significantly impacted by older business entities undertaking an IPO (Chang et al., 2008), providing higher earnings forecasts (Chen et al., 2004), setting lower offer price (Cheung et al., 2009), having a smaller offer size (Yu & Tse, 2006), reporting a higher number of risk factors and undergoing longer delays in listing (Guo & Brooks, 2008). In developed markets, older business entities are found to reduce ex-ante uncertainty and mispricing (Loughran & Ritter, 2004). However, we find the age of the business entity is directly correlated with the amount of mispricing. *Ceteris paribus*, Lin et al. (1998) argue that in a transition economy like China, older firms are associated with historical burdens while younger firms are likely to perform better. In such cases, older firms are associated with higher ex-ante uncertainty and will be more mispriced.

Table 6.7: OLS and QR estimates

Variables	**Full Sample**	**Median**	**Overpriced**	**Fairly priced**	**Underpriced**	**Highly underpriced**	**Extremely underpriced**
	OLS	**0.5**	**0.031**	**0.075**	**0.238**	**0.543**	**0.848**
(Intercept)	1.2198***	1.2960***	0.1170	1.2819	1.2579***	1.3167***	1.5506***
$logAssets_i$	-0.0006	0.0015	-0.0012	-0.0031*	-0.0005	0.0014	-0.0004
$logAge_i$	0.0228***	0.0241***	0.0169***	0.0107*	0.0248***	0.0236***	0.0101
EPS_i	0.0087**	0.0087***	0.0084**	0.0051**	0.0107***	0.0077***	-0.0002
$RetOwn_i$	0.0427	0.0387	-0.1181***	-0.0383	-0.0449	0.0444	0.0411
$logOS_i$	-0.1642***	-0.1694***	-0.1793***	-0.1632***	-0.1695***	-0.1702***	-0.1699***
IM_i	0.0221	0.0191	0.0204	0.0098	0.0319	0.0168	-0.0045
$InvOP_i$	0.7888***	0.6731***	0.6203***	0.6043***	0.5752***	0.6753***	0.7557***
UMS_i	-0.0209	-0.0079	-0.0256	-0.0415	0.0392	-0.0281	0.0575
VC_i	-0.0067	-0.0088	-0.0040	-0.0044	-0.0060	-0.0111*	-0.0124
RF_i	0.0005*	0.0001	0.0008***	0.0004*	0.0001	0.0002	0.0002
$MP30_i$	0.3732***	0.4109***	0.2967***	0.3242***	0.3850***	0.4106***	0.3936***
$Exchange_i$	-0.0262***	-0.0382***	-0.0373***	-0.0301***	-0.0397***	-0.0347***	-0.0234**
logLagDays	0.0087*	0.0172***	-0.0165*	-0.0018	0.0235***	0.0166***	0.0371***
$RelVol_i$	0.0908***	0.0787***	0.0712***	0.0863***	0.1256***	0.0645**	0.1099***
YearDummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$Adj.R^2$ / R^1	0.6968	0.4702	0.3767	0.3850	0.4300	0.4714	0.4929

1. The data sources are consistent with Table 6.3.
2. Estimated results are from equation 6.1. The dependent variable is the log of (First day closing price – Offer price)/Offer price. *LogAssets* is the logarithm of one plus pre-IPO total assets. *LogAge* is the logarithm of the firm's age in years calculated at the time of IPO from date of incorporation. *EPS* is earnings forecasts provided in the IPO prospectus. *RetOwn* is calculated as one minus the number of shares issued over total number of shares outstanding. *IM* is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. *LogOS* is the logarithm of offer size measured from the final offer price multiplied by the number of shares offered. *InvOP is* one divided by final offer price per share. *VC* is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. *UMS* is the underwriter's market share calculated through the capital raised by the underwriter in a year divided by capital raised by all the IPOs in that year. *RF* is the number of risk factors reported in the IPO prospectus. *logLagDays* is logarithm of no. of days between IPO date and listing date. *MP30* is the pre-IPO 30-day performance of the market index where the stock is listed. *Exchange* is a dummy variable with value of 0 if the IPO is listed on the SSE and 1 for the SZSE. *logLagDays* is the logarithm of one plus the no. of days between IPO date and listing date. *Realised Volatility* $_{t\text{-}30}$ is the 30-day pre-IPO volatility of the market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.
3. The first column provides the OLS estimates from Equation 6.1.
4. Column 2 provides median quantile estimates. Columns 2–7 provide QR estimates for the quantile points selected as mid-points of the sub-ranges defined in Table 6.5.
5. Coefficients significant at the levels of 1%, 5% and 10% are marked by ***, ** and * respectively.
6. *Adjusted* R^2 is the goodness of fit measure for OLS and R^1 is the goodness of fit measure for QR based on Koenker and Machado (1999).

Further, we find the expected positive relationships between the mispricing and the recent performance and volatility of the equity market (Kao et al., 2009). The positive sign on recent market performance suggests that issuers tend to issue their IPOs at times of high market performance. The positive sign on volatility suggests that the issuers price their shares lower than the equilibrium price during periods of high volatility. The significant and negative coefficient of the stock exchange dummy suggests that listing on SSE increases mispricing compared to SZSE. Lastly, consistent with the previous studies, we do not find any significant relationship between the role of the underwriter in the IPO and first day returns (Su & Brookfield, 2013). However, we observe a change in sign between the OLS and QR estimates.

It is important to note that both OLS and median QR examine central regions of the mispricing distribution – that is, the mean and the median. They do not examine the relationships between mispricing and independent variables at the more extreme regions of the distribution. In the next subsection, we use the QR method to examine the relationships between mispricing and explanatory variables at various levels of first day returns.

6.5.2 QR estimates

The QR results for the ranges that represent the various levels of mispricing in China are reported in columns 3 to 7 in Table 6.7. The QR results show that the impacts of the independent variables vary across the six levels of mispricing in terms of their sign, size and significance. These variations allow us to differentiate between the determinants of the IPOs across the various ranges.

The size of the firm ($logAssets_i$), age ($logAge_i$), earnings forecast (EPS_i), proportion of the shares retained ($RetOwn_i$), no. of risk factors reported in the prospectus (RF_i) and delay in the listing ($logLagDays_i$) exhibit varying relationships with different levels of mispricing. For example, retained ownership that has no impact on the overall level of mispricing (both the mean and the median levels), is found to positively contribute to mispricing of the overpriced IPOs. This suggests that, as argued by Clarkson et al. (1992), providing lower earnings forecasts and retaining a higher proportion of shares at the time of IPO while selling at high offer prices

triggers a less enthusiastic response from the investors in the aftermarket and may lead to overpricing.

Both size and earnings forecasts have a significant positive impact on mispricing across all ranges, with the exception of the extremely underpriced IPOs. The magnitude of the coefficients increase as we go from the overpriced to the highly underpriced IPOs, suggesting that the level of mispricing increases with increase in the earnings forecast and decreases in offer size. The coefficient of delay in listing is significant and negative for the overpriced IPOs and significant and positive for the underpriced IPOs, suggesting that longer delays in listing are associated with higher mispricing. This suggests that investors are compensated for holding the shares for a longer time period before the IPO lists on the exchange. An example of this is Shandong Jintai, with a delay of listing of 9.20 years. Shandong Jintai had 1278.84% returns. This is consistent with other studies on the Chinese market (e.g. Mok & Hui, 1998; Tian, 2011).

The variables of offer size ($logOS_i$), offer price ($InvOP_i$), market performance ($MP30_i$), exchange of listing ($Exchange_i$) and market volatility ($RelVol_i$) have similar effects regardless of the level of mispricing. Offer size has a significantly negative relationship across all levels of mispricing, suggesting that as the size of the offer decreases the initial returns increase. This implies that the smaller IPOs have higher ex-ante uncertainty and are more mispriced (Yu & Tse, 2006). The coefficients of recent market performance and market volatility are significant and positive. This is a common finding in IPO studies (e.g. Paudyal et al., 1998; Su & Brookfield, 2013). We extend the previous finding and argue that market performance and volatility have an increasing impact on initial returns. The coefficient of market performance ($MP30_i$), β_{11}, reflects the rate of change in stock performance as market performance changes. In other words, $\beta_{11} = \Delta RR_i / \Delta MP30_i$, implies that for an increasing impact of market performance (or market volatility) on the stock performance, the numerator (ΔRR_i) should have a higher rate of change compared to the denominator ($\Delta MP30_i$). This suggests that the IPOs in the Chinese market yield higher initial returns than those in the market index.[25] This is also the case

[25] The standard deviation of the first day returns is 2.127 compared to the standard deviations of Market Performance$_{t-30}$ and Realised Volatility$_{t-30}$ which are 0.1196 and 0.1284, respectively. Similarly, the standard deviation of the first day returns of the extremely underpriced IPOs (overpriced IPOs) is 3.35 (0.11) whereas

with the coefficient of market volatility. Lastly, reduction in the size of the coefficient of $Exchange_i$ suggests that the IPOs that are listed on the SSE are likely to have higher positive returns (underpricing).

6.5.3 Impact of change in pricing mechanism on mispricing

The Chinese IPO market has experienced various changes in IPO pricing mechanism over time. Variants of fixed pricing were used to price the IPOs but gradually transformed into the more market-oriented pricing mechanism of book building, which was formally adopted in January 2005. Previous studies comparing the fixed price method with book building indicate the latter is more efficient in reducing mispricing (Benveniste & Spindt, 1989; Engelen & van Essen, 2010).

To examine the impact of changes in the pricing regime in China we include in the regression specification a dummy term for each variable in Equation (6.1) which takes a value of zero for the period before 2005 and one otherwise, as shown in Equation (6.2). The impacts of independent variables on first day returns before and after the regime shift are reported in Table 6.8. The $X_{i,(pre)}$ reflects the coefficient of the independent variables before the regime shift. $X_{i,(diff)}$ is the difference between the coefficient value of the independent variables before and after the regime shift and $X_{i,(post)}$ is the coefficient of the independent variable after the regime shift. The analysis is conducted using Equation (6.2).

The OLS estimates are reported in column 1 of Table 6.8. The variables that are found to increase mispricing before 2005 are: age (+), offer price (+), market performance (+) and volatility (+). The factors that reduce mispricing for the same period are: offer size (-) and exchange (-). For the period from 2005 onwards, the factors that are found to increase the mispricing are: age (+), retained ownership (+), offer price (+), market performance (+) and volatility (-). The factors that reduce mispricing from 2005 onwards are: offer size (-) and exchange (-). A comparison of the estimates of the two periods shows that the factors impacted mispricing in the same way both before and after the change in the pricing mechanism. The ownership retained by the issuer has no impact on the mispricing pre-2005 but is found to have a significantly positive impact for 2005 onwards. The

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$MarketPerformance_{t-30}$ and $RealisedVolatility_{t-30}$ for these two levels of mispricing are 0.140 (0.07) and 0.158 (0.06), respectively.

Table 6.8: China OLS and QR estimates with regime dummy as interactive term with each variable

Variables	**Full sample**	**Median**	**Overpriced**	**Fairly priced**	**Underpriced**	**Highly underpriced**	**Extremely underpriced**
	OLS	**0.5**	**0.031**	**0.075**	**0.238**	**0.543**	**0.848**
(Intercept)	1.7463***	2.0244***	0.7045***	2.1590	2.1910***	2.0610***	2.1987***
logAssets (pre)	-0.0005	0.0016	-0.0065***	-0.0032*	-0.0007	0.0019*	0.0036
logAssets (diff)	-0.0002	-0.0037	0.0092***	0.0093**	0.0003	-0.0028	-0.0052
logAssets (post)	-0.0007	-0.0022	0.0026	0.0062	-0.0003	-0.0008	-0.0016
logAge (pre)	0.0210*	0.0265**	0.0440***	0.0147	0.0370***	0.0294***	0.0035
logAge (diff)	-0.0036	-0.0112	-0.0663***	-0.0113	-0.0260***	-0.0143*	0.0153
logAge (post)	0.0175*	0.0153**	-0.0223	0.0034	0.0110***	0.0151**	0.0188
EPS (pre)	0.0051	0.0073*	0.0046	0.0095**	0.0016	0.0049	0.0037
EPS (diff)	0.0046	0.0016	0.0026	-0.0047	0.0035	0.0021	-0.0075
EPS (post)	0.0097	0.0090*	0.0072	0.0047	0.0051	0.0070	-0.0038
RetOwn (pre)	-0.0584	-0.0290	-0.1501**	-0.0368	-0.1107**	-0.0007	-0.2491***
RetOwn (diff)	0.2180**	0.1082	0.0679	-0.0206	0.2038***	0.1208	0.5216***
RetOwn (post)	0.1595**	0.0792	-0.0823	-0.0574	0.0931	0.1201	0.2725***
logOS (pre)	-0.2130***	-0.2403***	-0.0656***	-0.2685***	-0.2691***	-0.2448***	-0.2181***
logOS (diff)	0.0598***	0.0879***	0.0235**	0.1625***	0.1329***	0.0842***	0.0492**
logOS (post)	-0.1533***	-0.1524***	-0.0421***	-0.1061***	-0.1362***	-0.1606***	-0.1690***
IM (pre)	0.0078	-0.0105	0.0159	0.0460	0.0043	-0.0146	0.0021
IM (diff)	0.0234	0.0764	0.0183	-0.0432	0.0461	0.0515	0.0152
IM (post)	0.0312	0.0659	-0.0342	0.0028	0.0504	0.0369	0.0173
InvOP (pre)	0.8299***	0.6430***	0.8136***	0.7392***	0.5363***	0.6953***	0.6032***
InvOP (diff)	-0.3532***	-0.1027	-0.4626***	-0.4395***	-0.2045**	-0.2393*	0.1395
InvOP (post)	0.4766***	0.5404***	0.3511***	0.2997***	0.3317***	0.4561***	0.7427***
UMS (pre)	-0.1422	-0.1270	-0.3461***	-0.1721*	0.0272	-0.2066**	0.0832
UMS (diff)	0.2361*	0.1763	0.3331***	0.3016***	0.1012	0.2771***	-0.0061
UMS (post)	0.0939	0.0494	-0.0131*	0.1295	0.1284	0.0705*	0.0771
VC (pre)	-0.0108	0.0000	-0.0573***	-0.0246	-0.0154	-0.0022	0.0034
VC (diff)	0.0066	-0.0098	0.0599***	0.0231	0.0134	-0.0087	-0.0130

Table 6.8 (continued)

Variables	Full sample	Median	Overpriced	Fairly priced	Underpriced	Highly underpriced	Extremely underpriced
	OLS	**0.5**	**0.031**	**0.075**	**0.238**	**0.543**	**0.848**
VC (post)	-0.0041	-0.0098	0.0026	-0.0015	-0.0020	-0.0109	-0.0096
RF (pre)	0.0068	0.0038	0.0011	-0.0048	-0.0018	-0.0004	0.0133
RF (diff)	0.0004	0.0030	-0.0010	0.0055	-0.0040	0.0065	-0.0096
RF (post)	0.0072	0.0069	0.0021	0.0007	-0.0058	0.0061	0.0037
MP30 (pre)	0.3796***	0.4006***	0.1504***	0.3353***	0.3548***	0.4068***	0.4119***
MP30 (diff)	-0.0266	0.0052	0.2837***	-0.0070	0.0522	-0.0193	0.0476
MP30 (post)	0.3530***	0.4058***	0.4340***	0.3283***	0.4070***	0.3875***	0.4595***
Exchange (pre)	-0.0145*	-0.0232**	-0.0244*	-0.0211**	-0.0229**	-0.0193**	-0.0015
Exchange (diff)	-0.0294	-0.0232	0.0085	0.0080	-0.0125	-0.0450**	-0.0338*
Exchange (Post)	-0.0438***	-0.0464***	0.0329	-0.0131	-0.0354**	-0.0643***	-0.0352
logLagDays (pre)	-0.0049	0.0055	-0.0086	-0.0265***	0.0157**	0.0039	0.0401***
logLagDays (diff)	0.0186	0.0145	0.0048	0.0167	-0.0087	0.0219	-0.0134
logLagDays (post)	0.0137	0.0199	-0.0038*	-0.0099**	0.0070*	0.0258	0.0267***
RelVol (pre)	0.0953***	0.0746**	0.0273	0.0376	0.1183***	0.0652*	0.0958*
RelVol (diff)	-0.0593	-0.0774	0.4905***	0.1441**	0.0053	-0.1198	-0.0397
RelVol (post)	0.0360**	-0.0027	0.5174*	0.1817	0.1236***	-0.0546	0.0561
YearDummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj.R^2 / R^1	0.7028	0.4836	0.4114	0.4195	0.4539	0.4847	0.5073

1. The data sources are consistent with Table 6.3.
2. Estimated results are from Equation 6.2. $X_{i,(pre)}$ is the coefficient of explanatory variables before the regime shift. The coefficient $X_{i,(diff)}$ reflects the difference between the coefficients of the independent variables before and after the regime shift. In order to get the coefficient of the independent variables after the regime shift ($X_{i,(post)}$) we add $X_{i,(pre)}$ and $X_{i,(diff)}$. The significance of $X_{i,(post)}$ is determined by using the Wald test. The dependent variable is the log of (First day closing price – Offer price)/Offer price. *LogAssets* is the logarithm of one plus pre-IPO total assets. *LogAge* is the logarithm of the firm's age in years calculated at the time of IPO from date of incorporation. *EPS* is earnings forecasts provided in the IPO prospectus. *RetOwn* is calculated as one minus the number of shares issued over the total number of shares outstanding. *IM* is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. *LogOS* is the logarithm of offer size measured from the final offer price multiplied by the number of shares offered. *InvOP is* one divided by final offer price per share. *VC* is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. *UMS* is the underwriter's market share calculated through the capital raised by the underwriter in a year divided by capital raised by all the IPOs in that year. *RF* is the number of risk factors reported in the IPO prospectus. *Exchange* is a dummy variable with value of 0 if the IPO is listed in the SSE and 1 for the SZSE. *logLagDays* is the logarithm of no. of days between IPO date and listing date. *MP30* is the pre-IPO 30-day performance of the market index where the stock is listed.
3. The first column provides the OLS estimates from Equation 6.2.
4. Column 2 provides median quantile estimates. Columns 3–7 provide QR estimates for the quantile points selected as mid-points of the sub-ranges defined in Table 6.3.
5. Coefficients significant at the levels of 1%, 5% and 10% are marked by ***, ** and * respectively.
6. *Adjusted* R^2 is the goodness of fit measure for OLS and R^1 is the goodness of fit measure for QR based on Koenker and Machado (1999).

coefficients of listing exchange suggest that IPOs listed in SSE are more mispriced during both periods. However, the magnitude of the impact of the variables decreased from the pre-2005 period to the period from 2005 onwards, reflecting the reduction in the level of mispricing of the two periods. This suggests that the introduction of a market-oriented method of pricing significantly contributed to the reduction in mispricing.

The application of QR across the levels of mispricing provides further insights into the changing impacts of the independent variables across the levels of mispricing. The estimates are reported in column 3 to 7 of Table 6.8. The results show that the impacts that the independent variables have on mispricing vary across the levels of mispricing as well as across the two periods.

While looking at the central region of the distribution we do not see any impact of firm size on mispricing. But the QR estimates that, before 2005, firm size has a significantly negative relationship with the mispricing of overpriced and fairly priced IPOs but has a significantly positive impact on the mispricing of highly underpriced IPOs. This suggests that as firm size increases, the magnitude of the mispricing increases. This relationship only holds for the pre-2005 period as firm size has no significant impact on mispricing from 2005 onwards. This change in impact is significant for overpriced and the fairly priced IPOs.

Age of the firm has a significantly positive impact on the overpriced, underpriced and highly underpriced IPOs pre-2005. For the period 2005 onwards, the age of the firm is only found to increase the mispricing of underpriced and highly underpriced IPOs. The change in the impact of firm age on mispricing during the two periods is significant.

Pre-2005, retained ownership has a significantly negative relationship with the mispricing of overpriced, underpriced and extremely underpriced IPOs. Retained ownership has no impact on mispricing for 2005 onwards, except in the case of extremely underpriced IPOs.

Offer size has a significantly negative impact across all levels of mispricing for both the time periods. The magnitude of the estimates suggests that as offer size decreases, the direction of the mispricing moves from being overpriced to

extremely underpriced. However, there is a decrease in the magnitude of $logOS_{(pre)}$ and $logOS_{(post)}$ suggesting a shift in impact due to the change in the pricing mechanism.

The offer price is found to have a significantly negative impact across all levels of mispricing both before and after the change in the pricing regime. The magnitude of the coefficients shows that as the offer price decreases, the IPOs are more mispriced. However, there is a decrease in the magnitude of the mispricing with the change in the pricing regime.

Underwriter reputation is found to decrease the mispricing of overpriced, fairly priced and the highly underpriced IPOs before 2005. However, for the period from 2005 onwards, the coefficient of underwriter reputation is significantly negative for overpriced IPOs and significantly positive for highly underpriced IPOs. This highlights the role of the underwriters after the introduction of the book building process. The relationship between mispricing and UMS_i changes from significantly negative for the overpriced IPOs to being significantly positive for the extremely underpriced IPOs. This finding supports the proposition by Aggarwal, Prabhala and Puri (2002) that in a book building pricing regime, underwriters underprice IPOs to please their investor clientele.

The difference between the offer date and the listing date (*logLagDays*), which is previously found to increase the mispricing, has a significantly positive impact on mispricing of underpriced IPOs for both the periods. But the magnitude of the impact decreases after the shifting to the book building method.

Consistent with Kao et al. (2009), recent market performance is found to increase mispricing in both the periods examined. Whereas, before 2005, market volatility has a significantly positive relationship with the three levels of the underpriced IPOs. However, market volatility does not have a systematic relationship with the mispricing in the 2005 onwards period, except that is has a significantly positive impact on overpriced and underpriced IPOs.

Now we move on to discuss the impact of the independent variables on each level of mispricing. The size of the firm, retained ownership, venture capitalist and listing exchange have a significantly negative impact on the extent of mispricing for

overpriced IPOs during the pre-regime period but have no significant relationships after the change in regime. On the other hand, age has a significantly positive impact on the extent of mispricing for overpriced IPOs before 2005 but has no significant relationship for 2005 onwards. Offer size, offer price and underwriter reputation have a significantly negative relationship with the extent of mispricing for overpriced IPOs both before and after the change in the pricing mechanism. While market performance has a significantly positive correlation with mispricing, indicating that issuers who overprice seem to take high market performance and volatility as an opportunity to maximise their IPO proceeds. A closer examination of these IPOs highlights three interesting facts: (a) all of the overpriced IPOs are fixed price; (b) issuers increase their potential wealth by overpricing[26]; and (c) these IPOs are the oldest companies and retain the highest proportion of ownership. These patterns suggest that the issuers gain more wealth than they would have generated if they had followed the book building method. However, after the shift in pricing regime, the market seems to reject the IPOs that have fixed prices, are older, retain a higher proportion of ownership and sell at higher offer prices.

Underpriced and highly underpriced IPOs show similar results in which mispricing is significantly impacted by age (+), retained ownership (+), offer price (+), offer size (-), underwriter reputation (-), recent market performance (+), listing on the SSE (-), lag between IPO date and listing date (+) and volatility (-). We see that most of the coefficients have decreased after the change in price regime. This suggests that the involvement of the market in the pricing of IPOs mitigates mispricing. However, the similarity between these two levels of mispricing is not without exceptions. For example, underwriter reputation has no impact on underpriced IPOs but we see a change in sign of the coefficient when the figure changes from -0.2066 to 0.0705. The change in sign suggests that underwriter reputation decreases underpricing in the pre-regime shift period whereas under the market-oriented pricing mechanism reputable underwriters tend to leave some money on the table to keep investors engaged. This explanation can be inferred from the positive insignificant coefficient of $UMS_{(post)}$ suggesting that for fairly priced IPOs, underwriter reputation has no impact. These results suggest that the

[26] This is based on the mispricing gain (loss) to the issuer's wealth, calculated following da Silva Rosa, Velayuthen and Walter (2003) where standard mispricing is adjusted for the proportion of the capital sold in the IPO i.e. $RR_{i,t} * (1 - RetOwn_i)$.

book building method gives underwriters some influence on the pricing of the IPOs, and by using that influence they tend to leave money on the table and establish their clientele by benefiting investors. This behaviour of benefiting investors and establishing clientele base has relevance in the context of the Chinese market because during the period when the market was controlled by strict government regulations (prior to 2004) and underwriters were state-controlled, underwriters had no incentive to misprice (Su & Brookfield, 2013). This finding is further strengthened by a reduction in the magnitude of the coefficient of UMS_i from -0.3461 ($UMS_{(pre)}$) to -0.0131 ($UMS_{(post)}$) for the overpriced IPOs and a change in the same coefficient from -0.2066 ($UMS_{(pre)}$) to +0.0705. ($UMS_{(post)}$), suggesting that larger underwriters have started to leave money on the table after the pricing method changed to book building. Similarly, highly underpriced IPOs are not impacted by the delay in listing and market volatility.

Lastly, the mispricing of the extremely underpriced IPOs is caused by higher retained ownership, smaller offer size and offer price, euphoric market and delay in listing. These results show that extreme levels of mispricing are caused by risk characteristics of the IPOs which put the investors at an information disadvantage. Therefore, issuers misprice these IPOs to compensate investors for the risk they take. It is worth noting that the issuers of extremely underpriced IPOs lose over half (53.80%) of their potential proceeds to underpricing. Surprisingly, we do not see that $Exchange_{(Post)}$ and $RelVol_{(Post)}$ have significant impacts on the extremely underpriced IPOs.

In summary, the adoption of the book building mechanism of IPO pricing significantly reduced the level of mispricing in Chinese IPOs, with a decrease of more than 100%. The current levels of mispricing are higher than those in other countries. The results are consistent with the expected signs and previous studies. The results also suggest a behavioural shift in investors' investment patterns, as is suggested by the differences in the $X_{i,(post)}$ coefficients of overpriced and extremely underpriced IPOs. Our results partially support the findings of Gao (2010) that the Chinese IPO returns can be explained by behavioural factors such as market sentiment. Further, consistent with Cao et al. (2013) we do not find any significant relationship between the involvement of venture capitalists and mispricing. However, the results suggest an increased role of underwriters in IPO mispricing.

The use of the QR method, using Equations 6.1 and 6.2, allowed us to explore the latent relationship between the levels of mispricing and the independent variables in Chinese IPOs. The coefficients obtained for Equations 6.1 and 6.2 show a varying relationship between the independent variables and the levels of mispricing. Panel A and Panel B of Table 6.9 report the estimates of the equality of slope parameters of Equations 6.1 and 6.2 across the five levels of mispricing. The comparison of the estimates shows that the differences in the impacts of the independent variables are significant at the 1% level across all the levels of mispricing. These tests show differences between the IPOs in two extreme regions, the highly overpriced and the extremely underpriced IPOs. This confirms that the impact that independent variables have on various levels of mispricing are significantly different across the mispricing distribution, and supports our use of the QR to explore those differences.

Table 6.9: Tests of the equality of slope estimates across quantiles

Panel A			
Level of mispricing	**Quantiles**	**Estimate**	**p-value**
Overpriced vs. extremely underpriced	0.031 vs. 0.848	8.93	0.000***
Fairly priced vs. highly underpriced	0.075 vs. 0.543	7.63	0.000***
Overpriced vs. underpriced	0.031 vs. 0.238	36.32	0.000***
All levels of mispricing	0.031 vs. 0.075 vs. 0.238 vs. 0.543 vs. 0.848	18.26	0.000***
Panel - B			
Overpriced vs. extremely underpriced	0.031 vs. 0.848	11.91	0.000***
Fairly priced vs. highly underpriced	0.075 vs. 0.543	6.98	0.000***
Overpriced vs. underpriced	0.031 vs. 0.238	6.11	0.000***
All levels of mispricing	0.031 vs. 0.075 vs. 0.238 vs. 0.543 vs. 0.848	8.02	0.000***

1. Panel A shows the F-statistics of the equality of slope estimates of Equation 6.1 across the selected quantiles representing the levels of the first day returns.
2. Panel B shows the F-statistics of the equality of slope estimates of Equation 6.2 across the selected quantiles representing the levels of the first day returns.
3. Coefficients significant at the levels of 1%, 5% and 10% are marked by ***, ** and * respectively.

6.6 Conclusion

This chapter has three main focuses. First, we identify the extent and distribution of the mispricing of Chinese IPOs. Second, we find the factors that contribute to the mispricing using OLS and QR approaches. Third, we study the impact of the adoption of the book building pricing method on mispricing.

Using a sample of 2199 IPOs listed on the SSE and the SZSE, we show that average mispricing is 112.10% with a median of 71.40% for the IPOs listed between 1995 and 2013. The mispricing distribution is skewed to the right, with 6.27% of IPOs being overpriced, and almost one-third of the sample IPOs have above-average returns. In contrast to Chen et al. (2004), we find that the IPOs listed on the SSE are significantly more mispriced than those listed on the SZSE.

We divided the IPOs into five groups based on direction of mispricing from lowest to highest as follows: overpriced IPOs, fairly priced IPOs, underpriced IPOs, highly underpriced IPOs, and extremely underpriced IPOs. Using a combination of OLS and QR methods, we find a variation in the relationship of the independent variables across the levels of the mispricing. The factors that explain the overpriced and fairly priced IPOs are different to those that explain the extremely underpriced IPOs. These differences are more pronounced between the tails of the distribution. Our analysis shows that overpriced IPOs are impacted by age, firm size, earnings forecast and offer size. However, the extremely underpriced IPOs are driven by high risk characteristics of the issuers who compensate investors for taking that risk, firm size, offer size, offer price and delay in listing. Although such companies are considered risky, they are able to list on the stock exchange and do not have the historical burden that older firms usually carry. The younger and smaller ventures attract investor interest and yield higher returns (Lin et al., 1998; Tian, 2011). In addition, we find that as market performance and market volatility increase, mispricing increases. We also find that mispricing is more prevalent in the SSE than the SZSE.

The adoption of the book building method of pricing has reduced mispricing from 169.70% to 61.20% and it has also reduced the skewness of the returns. We find that the change in the pricing mechanism has also changed the risk characteristics if firms going public. The factors that largely drive the pre-2005 mispricing do not have any significant impact in the period from 2005 onwards. This is observable in the coefficients of $logAssets_{(post)}$, $logAge_{(post)}$, $EPS_{(post)}$, and $RetOwn_{(post)}$ for overpriced and fairly priced IPOs. For the right side of the distribution (i.e. the IPOs with positive returns) we find that the change to the book building method reduced the magnitude of the coefficient of the independent variables for the three levels of underpriced IPOs. This is reflected in the $logAge_{(post)}$, $InvOP_{(post)}$, $UMS_{(post)}$, and

logLagDays$_{(post)}$. The results also highlight that reputable underwriters are also found to increase the underpricing of IPOs, which was previously not the case for the Chinese underwriters. Consistent with Cao et al. (2013), we find there is no systematic relationship between the involvement of venture capitalists and mispricing.

Chapter 7: Mispricing in Malaysia

7.1 Introduction

In this chapter, we examine the mispricing of Malaysian IPOs. Previous studies show a huge decline in the magnitude of the mispricing of Malaysian IPOs from 166.7% (Dawson, 1987) to 6.94% (Badru & Ahmad-Zaluki, 2018). We find an average mispricing of 1.80% in a sample of 419 Malaysian IPOs that were issued from 1995 to 2013. The extent of the mispricing ranges from -94.77% to 1566.67%, where 59.42% of the sample IPOs are overpriced and only 18.85% of the sample IPOs have above average returns. The distribution of these returns is skewed to the right, with a median mispricing of -17.53%. In order to gain greater insights into the factors contributing to mispricing, we divide the sample into four levels based on the direction and magnitude of the mispricing: highly overpriced IPOs, overpriced IPOs, fairly priced IPOs and underpriced IPOs. The IPOs show varying characteristics across the four levels. Firms with larger assets, greater ages, larger offer sizes, and reputable underwriters tend to be the more underpriced, while firms that provide the highest earnings forecasts are highly overpriced. Firms with small sizes, average ages, higher earnings forecasts and high offer prices are overpriced.

The Malaysian market is of interest as it is categorised as an emerging market by MSCI, but with some of characteristics that make it different from other emerging markets. Firms that go public have a choice to list on either the Main Market or the ACE Market of the stock exchange. Listing on the Main Market has stricter criteria than the ACE Market. The key requirements for listing on the two markets are summarised in Table 7.1.

The companies seeking to be listed on the Main Market are required to obtain approval from the SC to have their prospectuses registered. They are also required to show a track record of profitability for the last three to five years. In contrast, firms seeking to be listed on the ACE Market are only required to have their prospectuses reviewed by the SC before they are registered. Thereafter, ACE Market companies undergo a tutoring period with a financial institution, which acts as a sponsor, and assesses the company's suitability for listing. A list of prescribed

financial institutions who can be involved as sponsors[27] is provided by Bursa Malaysia. The IPO prospectuses require wide disclosure, including: financial performance and profits, forecast profits (such as forecast earnings per share) and the potential risk factors affecting the issue. The earnings forecasts need to be verified by the reporting accountant and the issuer is also required to provide commentary on the steps taken to mitigate the potential risk factors affecting the issue. These features suggest that companies listed on the ACE Market are likely to be risky and more mispriced.

Table 7.1: Listing requirements for listing on Main Market and Ace Market

Criteria	Main Market	ACE Market
Profit test	Continuous profit after tax for three to five financial years with cumulative sum of not less than RM 20 million, where the most recent year's profit after tax must be at least RM 6 million.	No minimum profit requirement.
Public spread	At least 25% of the share capital with a minimum of 1000 public shareholders having no less than 100 shares each.	At least 25% of the share capital with a minimum of 200 public shareholders having no less than 100 shares each.
Bumiputera equity requirement	50% of public shares to be allocated to Bumiputera investors.	No allocation requirement at the time of listing. However, 12.5% of the paid up capital is required to be allocated to Bumiputera investors within a period of one to five years from the date of listing depending on the profitability of the company.
Sponsorship	Not applicable.	Sponsor to be engaged to ascertain listing suitability and is required for at least three years post listing.
Financial position and liquidity	Sufficient working cash flow for at least 12 months with positive cash flow from operating activities and no accumulated losses in the latest audited balance sheet.	Sufficient working cash flow for at least 12 month.
Lockup period	Six months from the date of listing	Six months from the date of listing for all the shares held. Later, at least 45% of the shares must be held for another six months and thereafter the shares can be sold over a period of three years.

1. The table compares listing requirements of Main Market and ACE Market.

[27] A sponsor is a financial institution that is a go-to entity for the firm seeking to list in the ACE Market. The sponsor determines the suitability of a business to be listed and continues to advise and guide the listed company on the requirements it needs to meet for a period of at least three years post listing.

7.2 Studies in Malaysia

A summary of IPO mispricing in Malaysia is provided in Table 7.2 where the early evidence of IPO studies goes back to Dawson (1987) who studies a sample of 21 Malaysian IPOs and finds an average mispricing of 166.6%. Studies that followed continued to report Malaysian IPOs being mispriced. It is observed that the magnitude of mispricing has decreased over time from 99.25% (Jelic et al., 2001) to 6.94% (Badru & Ahmad-Zaluki, 2018).

Table 7.2: Mispricing of Malaysian IPOs

Study	Period	N	Mean (%)	Median (%)
Dawson (1987)	1978 – 1983	21	166.6	-
Mohamad et al. (1994)	1975 – 1990	65	135	-
Paudyal et al. (1998)	1984 – 1995	95	61.80	40.50
Jelic et al. (2001)	1980 – 1995	182	99.25	79.04
Corhay et al. (2002)	1992 – 1996	258	41.7	32.21
Prasad, Vozikis & Ariff (2006)	1968 – 1975	38	57	-
Prasad et al. (2006)	1976 – 1992	75	118	-
Ahmad-Zaluki et al. (2007)	1990 – 2000	454	95.2	76.5
Murugesu & Santhapparaj (2010)	1999 – 2004	210	1.82	1.63
Low & Yong (2011)	2000 – 2007	368	30.83	19.74
Rahim, Embi & Yong (2012)	1999 – 2008	384	30.21	18.13
Younesi et al. (2012)	2007 – 2010	66	7.34	-
Badru & Ahmad-Zaluki (2018)	2005 – 2015	220	6.94	4.55

1. The table summarises evidence of IPO mispricing in Malaysia.

Like other markets, there is an observable difference between the mean and the median levels of mispricing of Malaysian IPOs. Paudyal et al. (1998) examine 95 Malaysian IPOs issued from 1984 to 1995 and find mean and median returns to be 61.80% and 40.50% respectively. Ahmad-Zaluki et al. (2007) report that a sample of 454 IPOs issued between 1990 and 2000 have a mean (median) mispricing of 95.2% (76.5%). Low and Yong (2011) show that 368 IPOs issued between 2000 and 2007 have a mean mispricing of 30.83% and a median of 17.94%. A more recent study by Badru and Ahmad-Zaluki (2018) shows mean and median mispricing of 6.94% and 4.55% respectively in a sample of 220 IPOs issued between 2005 and 2015.

The above discussion and the statistics reported in Table 7.2 highlight two features of the mispricing of Malaysian IPOs: (a) There is a difference between the mean and the median levels of mispricing (wherever reported), (b) the magnitude of mispricing has declined over the years.

Studies that examine mispricing in Malaysia show that the factors that are found to contribute to the mispricing are: larger size (Badru & Ahmad-Zaluki, 2018), lower age (Jelic et al., 2001), higher retained ownership (Paudyal et al., 1998), small offer size (Corhay et al., 2002), large offer price (Rashid, Abdul-Rahim & Yong, 2016), higher underwriter reputation (Paudyal et al., 1998; Murugesu & Santhapparaj, 2010), high market performance (Jelic et al., 2001), and market volatility (Paudyal et al., 1998). On the other hand, the factors that are found to reduce the level of mispricing are: large offer size and concentrated ownership structure (Rahim et al., 2012).

Table 7.3: Definitions of independent variables

Variable	Definition	Expected Sign
$logAssets_i$	Logarithm of one plus pre-IPO total assets	-
$logAge_i$	Logarithm of the firm's age in years calculated from the difference of the foundation year and the time of the IPO.	-
EPS_i	The forecast earnings per share given in the prospectus.	-
$RetOwn_i$	Calculated as one minus the number of shares issued / total number of shares outstanding.	-
$logOS_i$	Logarithm of offer size measured from the final offer price multiplied by the number of shares offered.	+
IM_i	A dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers.	+
$InvOP_i$	One divided by final offer price per share.	-
UMS_i	Underwriter Market Share is calculated as the sum of total capital raised in IPOs by the underwriter in a year 't', divided by the total capital raised by all the IPOs in the year 't'.	-
VC_i	A dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise.	-
RF_i	No. of Risk Factors measures the risks reported in the IPO prospectus.	-
$MP30_i$	The pre-IPO 30-day performance of the FTSE Bursa Malaysia Index.	+
$Board_i$	A dummy variable with a value of 1 for IPOs listed in the Main Market and 0 for the ACE Market.	-
$RelVol_i$	Realised volatility of 30 days pre-IPO is calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$	+

1. The table summarises the expected signs of the relationships between the independent variables and the first day IPO returns.

7.3 Method

The empirical model for examination of mispricing of the sample of Malaysian IPOs is presented in Equation (7.1). We use, X_{it}^{j}, the firm-level explanatory variables (discussed in Section 3.2.2) and year dummies, X_{it}^{m}, to control for time

effects, as shown in Equation (3.3). To capture the setting of the Malaysian IPO market we add a dummy variable $Board_i$ to our model. $Board_i$ takes a value of 1 if the IPO is listed on the Main Market and 0 for the ACE Market. The definitions of the independent variables and the expected signs of their relationships with the first day IPO returns are summarised in Table 7.3.

$$\begin{aligned} log\ RR_{i,t} = \alpha &+ \beta_1 logAssets_i + \beta_2 logAge_i + \beta_3 EPS_i + \beta_4 RetOwn_i \\ &+ \beta_5 logOS_i + \beta_6 IM_i + \beta_7 InvOP_i + \beta_8 UMS_i + \beta_9 VC_i \\ &+ \beta_{10} RF_i + \beta_{11} MP30_i + \beta_{12} Board + \beta_{13} RelVol_i \\ &+ \Sigma Year_i + \varepsilon_{i,t} \end{aligned} \quad (7.1)$$

Table 7.4: Descriptive statistics of the Malaysian sample

Variables	Mean	St. Dev	Median	Skewness
First day returns (%)	1.80%	138.30%	-17.53%	7.35
Offer price (MYR)	1.27	0.96	1.00	1.55
Assets (MYR M.)	158.26	658.63	12.40	7.75
Age (years)	6.01	10.57	2.44	5.84
EPS (MYR)	12.42	14.88	7.78	1.43
Retained Ownership (%)	72.30%	14.60%	75.00%	-2.25
Offer Size (MYR M.)	130.23	700.84	20.63	12.35
Issue Method	0.96	0.19	1.00	-4.84
Inverse offer price	1.42	1.23	1.00	1.87
Underwriter Market Share	0.10	0.14	0.04	2.71
Venture Capitalist	0.02	0.16	0.00	5.94
No. of Risk Factors	18.58	7.31	19.00	0.19
$MarketPerformance_{t-30}$ (%)	0.60%	6.20%	1.00%	0.82
Board	0.52	0.50	1.00	-0.09
$Realised\ Volatility_{t-30}$ (%)	12.9%	83.8%	10.80%	3.53
No. of IPOs	419			

1. The names and listing dates of 459 Malaysian IPOs issued during our sample period were obtained from Bursa Malaysia. The offer prices of the IPOs and all the independent variables except for market performance were obtained from the IPO prospectuses available on the Thomson One Banker and Bursa Malaysia websites. The daily adjusted trading prices of the stocks included in our sample and the FTSE Bursa Malaysia Index, which is used as a benchmark for market performance, were collected from DataStream. The construction of the final sample for the analysis involved certain adjustments. The firms with unavailable prospectuses, unavailable historical prices, unit trusts, stapled securities and issues without a public offer component were excluded, leaving a final sample size of 419 IPOs.
2. The table summarises descriptive statistics of the dependent and independent variables used in the study.
3. The first day returns are calculated as (First day closing price – Offer price)/Offer price. Assets are pre-IPO total assets. Age is the firm's age in years calculated at the time of IPO from date of incorporation. EPS is the forecast earnings per share given in the prospectus. Retained Ownership is one minus the number of shares issued over total number of shares outstanding. Offer Size is measured as the final offer price multiplied by the number of shares offered. Issue Method is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. Inverse offer price is one divided by final offer price per share. Underwriter Market Share is calculated as the sum of total capital raised in IPOs by the underwriter in a year *t*, divided by the total capital raised by all the IPOs in the year *t*. Venture Capitalist is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. No. of Risk Factors measures the risks reported in the IPO prospectus. $MarketPerformance_{t-30}$ is the pre-IPO 30-day performance of the FTSE Bursa Malaysia Index. Board is a dummy variable with value of 1 for IPOs listed in the main market and 0 for the ACE Market. $Realised\ Volatility_{t-30}$ is the 30-day pre-IPO volatility of market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.

7.4 Sample characteristics

7.4.1 Descriptive statistics

The descriptive statistics for the main variables are reported in Table 7.4. The average return of the sample IPOs is 1.80% which is consistent with recent studies (Murugesu & Santhapparaj, 2010; Younesi et al., 2012; Badru & Ahmad-Zaluki, 2018) and lower than that of the older firms (Corhay et al., 2002). The median level of mispricing is -17.53% where 59.42% of the sample IPOs are overpriced and only 18.85% have above average returns. The average age of the companies in our sample is approximately six years which is much less than the 19.57 years reported in Jelic et al. (2001), but close to the 5.53 years reported by Ammer and Ahmad-Zaluki (2016). The total money raised by the IPOs over our sample period is MYR 54.57 billion with an average offer size of MYR 130.23 million.

The issuing companies retained 72.30% of the ownership on average, which is close to the 74.18% reported by Paudyal et al. (1998). Further, the proportion of the ownership retained by Malaysian issuers is close to what is retained by Chinese issuers (72.90%) but much higher than the proportion retained by US issuers (11.50%). Since the commonly used method of pricing is the fixed price method, 96.20% of IPOs in our sample are priced using the fixed price method. Unlike the US only 2.60% of the sample IPOs have VC backing. Lastly, 52.20% of the IPOs are listed on the Main Market and the rest (47.80%) are listed on the ACE Market.

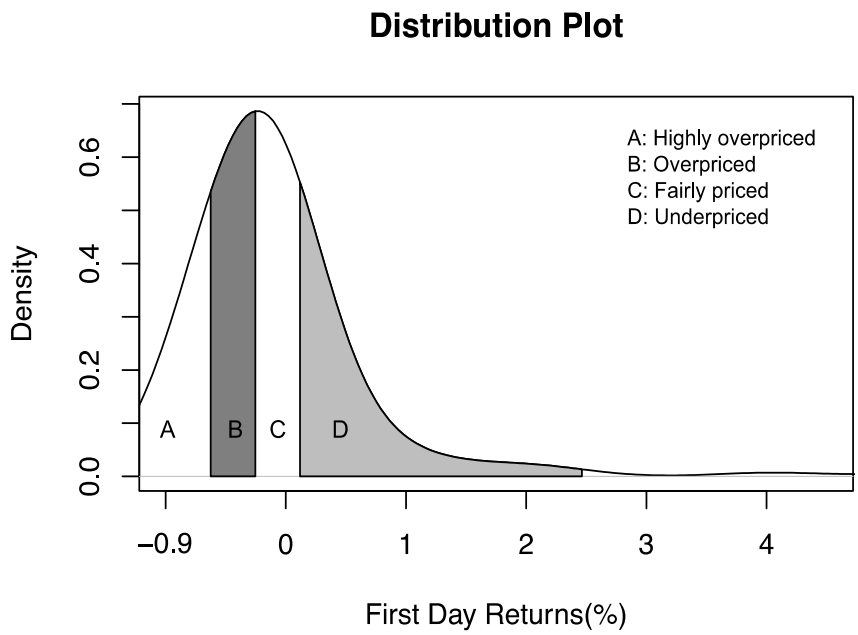
7.4.2 Levels of mispricing

The differences between the mean and median, and the skewness of the first day returns reported in Table 7.4, suggest that the distribution of the first day IPOs returns in Malaysia is not normal. The right-skewed distribution of the first day IPOs returns is clearly observable from the distribution plot in Figure 7.1.[28] As mentioned above, examining the mean of the distribution would provide an inflated picture of the first day IPOs returns and information at the tails of the distribution would not be captured. To gain further insights into the characterises of the IPOs across the mispricing distribution, we divide our sample into three sub-categories: IPOs with negative returns called overpriced IPOs (these are at the left-hand side

[28] The findings from applying the Shapiro-Wilk test for normality support the conclusion that the mispricing distribution is non-normal.

of the distribution), IPOs with zero returns called fairly priced IPOs (these are in the middle of the distribution) and IPOs with positive returns called underpriced IPOs (these are at the right-hand side of the distribution).

Figure 7.1: Distribution plot showing Malaysian IPO mispricing



Due to the larger number of IPOs with negative returns we further sub-divide the IPOs with negative returns into two (almost) equal sub-categories: highly overpriced and overpriced. This gives us four sub-ranges dividing the distribution of the mispricing, from left to right, into highly overpriced, overpriced, fairly priced and underpriced IPOs. The descriptive statistics of these sub-ranges are reported in Table 7.5. We find that it is the larger and older firms with larger offer sizes that tend to be the more underpriced while the firms that provide the highest earnings forecasts are highly overpriced. Further, we see that the firms which use high-reputation underwriters (underwriters with higher market share) are underpriced. Last, firms that go public during periods of high market performance are likely to be more underpriced. Further, the market seems to react negatively to market volatility, as we see a 'u-shaped' relationship between mispricing and realised volatility where higher levels of volatility are associated with higher mispricing. Table 7.5 shows that the IPOs within each level of mispricing have varying characteristics. We examine the impact that these varying characteristics have on the levels of mispricing in the next section.

Table 7.5: Variable means by the extent of mispricing

Variables	Highly Overpriced	Overpriced	Fairly Priced	Underpriced
	0 – 0.295	**0.295 - 0.594**	**0.594 - 0.775**	**0.775 - 1**
First day returns (%)	-64.90%	-23.40%	0.00%	125.00%
Assets (MYR M.)	63.13	106.19	122.17	382.16
Age (years)	5.86	5.99	4.61	7.37
EPS	15.52	12.78	4.98	13.86
Retained Ownership (%)	72.20%	72.00%	72.90%	72.50%
Offer Size (MYR M.)	34.12	174.23	114.66	211.07
Issue Method	0.97	0.99	0.95	0.91
Inverse offer price	1.21	1.30	1.89	1.47
Underwriter Market Share	0.03	0.02	0.03	0.03
Venture Capitalist	0.07	0.09	0.08	0.14
No. of Risk Factors	17.35	18.96	21.74	17.15
$MarketPerformance_{t-30}$ (%)	0.10%	0.50%	0.80%	1.40%
Board	0.46	0.47	0.63	0.57
$RealisedVolatility_{t-30}$ (%)	15.00%	12.80%	10.70%	11.90%
No. of IPOs	124	125	76	94

1. The data sources are consistent with Table 7.4.
2. The table breaks down the means of the variables for various sub-ranges of our data based on the magnitude of the mispricing of the IPOs as follows: the highly overpriced IPOs (i.e. the top 29.5% of the sample when the IPOs are ranked from the most overpriced to the most underpriced), the overpriced IPOs (ranked from 29.5% to 59.4%), the fairly priced IPOs (ranked 59.4% to 77.5%) and the underpriced IPOs (ranked from 77.5% to 100%).
3. The first day returns are calculated as (First day closing price – Offer price)/Offer price. Assets are pre-IPO total assets. Age is the firm's age in years calculated at the time of IPO from date of incorporation. EPS is the forecast earnings per share given in the prospectus. Retained Ownership is one minus the number of shares issued over total number of shares outstanding. Offer Size is measured as the final offer price multiplied by the number of shares offered. Issue Method is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. Inverse offer price is one divided by final offer price per share. Underwriter Market Share is calculated as the sum of total capital raised in IPOs by the underwriter in a year *t*, divided by the total capital raised by all the IPOs in the year *t*. Venture Capitalist is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. No. of Risk Factors measures the risks reported in the IPO prospectus. $MarketPerformance_{t-30}$ is the pre-IPO 30-day performance of the FTSE Bursa Malaysia Index. Board is a dummy variable with a value of 1 for IPOs listed in the Main Market and 0 for the ACE Market. $Realised\ Volatility_{t-30}$ is the 30-day pre-IPO volatility of market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.

Table 7.6: Descriptive statistics with respect to Main and ACE markets

Variables	Main market				ACE market				Main – ACE market	
	Mean	**SD**	**Median**	**Skewness**	**Mean**	**SD**	**Median**	**Skewness**	**Mean diff.**	**t-stats**
First day returns (%)	-1.06%	86.50%	-4.43%	3.38	5.01%	178.78%	-25.00%	6.73	-6.07	-0.43
Assets (MYR M.)	275.03	894.52	51.56	5.56	30.40	56.46	5.59	4.15	244.62	4.03***
Age (years)	7.72	12.29	2.78	4.72	4.15	7.91	2.04	9.02	3.57	3.56***
EPS	12.72	14.15	9.74	0.92	12.10	15.68	5.47	1.85	0.62	0.42
Retained Ownership (%)	71.36%	14.09%	74.25%	-1.88	73.37%	15.20%	75.00%	-2.65	-0.02	-1.39
Offer Size (MYR M.)	231.34	959.11	37.07	8.96	19.52	21.04	14.29	5.41	211.82	3.26***
Issue Method	0.93	0.25	1.00	-3.44	1.00	0.07	1.00	-14.14	-0.06	-3.56***
Inverse offer price	1.48	1.03	1.25	1.60	1.05	0.84	0.75	1.38	0.42	4.64***
Underwriter Market Share	0.12	0.17	0.05	2.27	0.07	0.09	0.04	2.45	0.05	3.75***
Venture Capitalist	0.04	0.19	0.00	4.98	0.02	0.12	0.00	8.04	0.02	1.44
No. of Risk Factors	19.08	7.88	19.00	0.38	18.04	6.61	19.00	-0.27	1.04	1.46
$MarketPerformance_{t-30}$ (%)	0.39%	5.45%	1.35%	-0.54	0.90%	6.89%	0.39%	1.50	0.38	-0.83
Realised volatility $_{t-30}$ (%)	12.36%	7.39%	10.72%	3.28	13.49%	9.33%	10.81%	3.55	-1.13	-1.36
No. of IPOs	219				200					

1. The data sources are consistent with Table 7.4.
2. The table summarises descriptive statistics of dependent and independent variables of the IPOs listed in the Main and ACE markets
3. The first day returns are calculated as (First day closing price – Offer price)/Offer price. Assets are pre-IPO total assets. Age is the firm's age in years calculated at the time of IPO from date of incorporation. EPS is the forecast earnings per share given in the prospectus. Retained Ownership is one minus the number of shares issued over total number of shares outstanding. Offer Size is measured as the final offer price multiplied by the number of shares offered. Issue Method is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. Inverse offer price is one divided by final offer price per share. Underwriter Market Share is calculated as the sum of total capital raised in IPOs by the underwriter in a year *t*, divided by the total capital raised by all the IPOs in the year *t*. Venture Capitalist is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. No. of Risk Factors measures the risks reported in the IPO prospectus. $MarketPerformance_{t-30}$ is the pre-IPO 30-day performance of the FTSE Bursa Malaysia Index. Realised $Volatility_{t-30}$ is the 30-day pre-IPO volatility of market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.
4. Mean differences significant at the levels of 1%, 5% and 10% are marked by ***, ** and * respectively.

7.4.3 Mispricing in the Main and the ACE markets

Table 7.6 reports the descriptive statistics of the key variables of the IPOs listed on the Main and the ACE markets. The IPOs listed on the Main market are on average mispriced by -1.06% and average mispricing of the IPOs listed on the ACE market is 5.01%. There are some observable difference in the characteristics of the IPOs listed on the two markets. The firms that list on the ACE market are smaller in size and are younger. These firms have smaller offer size and use less reputable underwriters. The characteristics of the firms listed on the ACE market reflect higher risk profile and are more mispriced.

7.5 Results and discussion

7.5.1 OLS and median regression estimates

The first column of Table 7.7 reports the OLS coefficients of Equation (7.1). Applying the traditional OLS regression, the variables for which coefficients are significant are: earnings forecast (-), offer price (+), the underwriter's market share (+), market performance (+) and realised volatility (-). Consistent with previous studies, we find that the issuers providing lower earnings forecasts are associated with higher mispricing (Jelic et al., 2001), and that having a more reputable underwriter increases underpricing (Paudyal et al., 1998). The positive significant coefficient of $InvOP_i$ is consistent with Malaysian studies that examine IPO mispricing (e.g. Rashid, Abdul-Rahim & Yong, 2014; Badru & Ahmad-Zaluki, 2018). This suggests that risky firms have an incentive to price their IPOs lower to attract investors to gain adequate subscriptions (Brennan & Hughes, 1991; Chowdhry & Sherman, 1996; Bradley & Jordan, 2002).

Last, the negatively significant coefficient of $RelVol_i$ suggests that the periods of high market volatility reduce mispricing. A plausible explanation for this is a buildup of negative sentiment in the market during the periods of high volatility which leads to a reduction in returns. This explanation is supported by the negative correlation between market sentiment ($MP30_i$) and realised volatility ($RelVol_i$) where the former has a significantly positive impact on mispricing.

Table 7.7: OLS and QR estimates

Variables	**Full Sample**	**Median**	**Highly overpriced**	**Overpriced**	**Fairly priced**	**Underpriced**
	OLS	**0.5**	**0.148**	**0.446**	**0.686**	**0.889**
(Intercept)	0.0658	-0.0995	0.0736	-0.2285	0.1032	1.7269
$logAssets_i$	-0.0084	-0.0069*	-0.0145**	-0.0094*	-0.0021	-0.0040
$logAge_i$	-0.0047	-0.0106	0.0706**	-0.0145	-0.0152	-0.0122
EPS_i	-0.00345**	-0.0024***	-0.0036	-0.0023	-0.0020*	-0.0035***
$RetOwn_i$	0.0537	0.0842	0.1146	0.1595	0.0516	-0.0203
$logOS_i$	0.0433	0.0361	0.0254	0.0547*	0.0181	0.0379
IM_i	-0.0666	-0.0252	-0.0644	-0.0214	-0.0189	-0.4655***
$InvOP_i$	0.0544***	0.0438***	0.0560**	0.0479***	0.0379***	0.0533***
UMS_i	0.3668***	0.2698**	0.4831**	0.3133**	0.1914**	0.1023
VC_i	-0.0823	-0.1189	-0.3287	-0.0647	0.0298	0.1562
RF_i	-0.0010	-0.0871	-0.1984	-0.1522	-0.0811	-0.0628
$MP30_i$	0.50742*	0.4956**	0.2080	0.5631**	0.4262*	0.6873**
$Board_i$	-0.0095	0.0399	-0.1109**	0.0231	0.0677***	0.0362
$RelVol_i$	-0.5561*	-0.8365**	-0.3923*	-0.9164**	-0.0677	-0.4405**
YearDummies	Yes	Yes	Yes	Yes	Yes	Yes
$Adj.R^2$ / R^1	0.1953	0.0976	0.1922	0.0997	0.0700	0.2454

1. The data sources are consistent with Table 7.4.
2. Estimated results are from Equation 7.1. The dependent variable is the log of (First day closing price – Offer price)/Offer price. *LogAsset*s is the logarithm of one plus pre-IPO total assets. $LogAge_i$ is the logarithm of the firm's age in years calculated at the time of IPO from date of incorporation. EPS_i is forecast earnings per share given in the prospectus. $RetOwn_i$ is calculated as one minus the number of shares issued over the total number of shares outstanding. $logOS_i$ is the logarithm of offer size measured from the final offer price multiplied by the number of shares offered. IM_i is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. $InvOP_i$ is one divided by final offer price per share. UMS_i is calculated as the sum of total capital raised in IPOs by the underwriter in a year *t*, divided by the total capital raised by all the IPOs in the year *t*. VC_i is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. RF_i is the number of risk factors reported in the IPO prospectus. $MP30_i$ is the pre-IPO 30-day performance of the FTSE Bursa Malaysia Index. $Board_i$ is a dummy variable with a value of 1 for IPOs listed on the main market and 0 for the ACE Market. Realised $Volatility_{t-30}$ is the 30-day pre-IPO volatility of the market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.
3. The first column provides the OLS estimates from Equation 7.1
4. Column 2 provides median quantile estimates. Columns 3–6 provide QR estimates for the quantile points selected as mid-points of the sub-ranges defined in Table 7.5.
5. Coefficients significant at the levels of 1%, 5% and 10% are marked by ***, ** and * respectively.
6. *Adjusted* R^2 is the goodness of fit measure for OLS and R^1 is the goodness of fit measure for QR based on Koenker and Machado (1999).

Comparing the results of OLS regression with the QR regression on median QR (column 2 of Table 7.7), the five variables that are significant under the OLS regression remain significant under the median regression. In addition, we also find that larger companies tend to be less mispriced. This is consistent with Beatty and Welch (1996), suggesting that larger firm size reduces uncertainty and the resulting mispricing.

A significant difference between the OLS and median QR results is the decrease in the size of coefficients for the QR, except for $RelVol_i$ which increases in size. As we know that the median returns are less than the mean ones, the increase in the coefficient of realised volatility for the median QR confirms our previous finding that a higher level of volatility creates negative market sentiment and results in a decrease in the magnitude of the mispricing of Malaysian IPOs.[29]

A comparison between OLS and the median QR reveals differences between the coefficients of the two models in terms of their magnitude and significance. The difference between the estimates of OLS and the median QR is partially driven by the asymmetric relationship between the mispricing and the factors that explain the mispricing, and the strong impact that highly underpriced IPOs (IPOs on the right tail of distribution) have on the mean of the distribution.

Both OLS and the median QR examine the mispricing at the central regions of the distribution. As a result the relationship between the mispricing and the independent variables at the tails of the distribution risks remaining unexamined, and the information that these tails provide, could be ignored. In the next subsection, we use the QR method to examine the relationships between mispricing and the explanatory variables for various levels of the former.

7.5.2 QR estimates

The results reported in columns 3 to 6 of Table 7.6 are the QR estimates across various levels of mispricing. The reference point is set at the midpoint of each mispricing range. As can be seen, there are considerable variations in the size, sign and significance of the coefficients of the independent variables across the levels

[29] The value of realised volatility corresponding to the median returns of -17.53% is 24.59% whereas the mean of the realised volatility is 12.90%.

of mispricing. For example, the size of the firm is significantly negative for the highly overpriced and the overpriced IPOs. The age of the firm, which had no significant impact on the central regions of the mispricing, is found to increase the mispricing of the overpriced IPOs. Earnings per share forecast has a significantly negative impact on the mispricing of the fairly priced and the underpriced IPOs.

The variable that has a significantly positive impact across all the levels of the mispricing is offer price. This suggests that as the offer price increases, the magnitude of mispricing increases. This pattern supports our earlier inference that risky firms tend to price their IPOs lower to attract investors and gain subscriptions.

Other variables that explain three out of the four levels of mispricing are: underwriter reputation, recent market performance and volatility, and listing board. The positive and significant relationships of underwriter reputation with the highly overpriced IPOs, overpriced IPOs and fairly priced IPOs suggest that as underwriter reputation increases, the magnitude of overpricing increases. In contrast to the other markets such as the US, where reputable underwriters are found to increase underpricing (Dolvin & Jordan, 2008), Malaysian underwriters tend to favour the issuers by overpricing the IPOs. Beatty and Ritter (1986) and Dunbar (2000) suggest that, in an environment where IPOs are fixed priced, underwriters have to maintain better relationships with the issuers to protect their clientele and do not have to favour investors as they usually do in the book building process (Benveniste & Spindt, 1989).

The significantly positive impacts of recent market performance on overpriced, fairly priced and underpriced IPOs suggest that euphoric markets increase the mispricing of underpriced IPOs, but have no impact on overpriced IPOs. Similarly, market volatility is found to reduce mispricing, suggesting that high volatility triggers negative reactions in the market and results in a price drop for IPOs.

From column 3 to column 6, the impact of the independent variables across the levels of mispricing show that the factors that explain mispricing do not have a uniform relationship across the mispricing distribution. The factors that increase the mispricing of the highly overpriced IPOs are age, higher offer price, smaller size and reputable underwriter, whereas the factor that goes against the mispricing is market volatility. A significantly negative coefficient of $Board_i$ suggests that in

the ACE Market, IPOs tend to be highly overpriced. Similarly, for the overpriced IPOs, the factors that increase the mispricing are smaller firm size, larger offer size, higher offer price, and reputable underwriters. On the other hand, realised volatility tends to work against overpricing. These results are consistent with previous studies.

Lastly, the underpriced IPOs are those which go public during periods of high market performance and lower market volatility. In these periods, an overreaction is created in the market which leads to higher first day returns. The other variables that have significant relationships with the underpriced IPOs are earnings forecast (-), issue method (-) and offer price (+), suggesting that book-built IPOs selling at lower offer prices and providing fewer earnings forecasts yield positive returns. The positive coefficient of UMS_i suggests that in a book building process underwriters leave some money on the table to maintain their relationships with the investors (Aggarwal et al., 2002); however, the insignificance of the coefficient suggests that underwriter reputation itself does not have any impact on the underpricing of the IPOs.

The QR coefficients of Equation 7.1 show a varying relationship between the independent variables and levels of mispricing. Table 7.7 reports the estimates of the equality of slope parameters of Equations 7.1, across the four levels of mispricing. A comparison of the estimates shows that the differences in the impacts of the independent variables are significant at the 1% level across all the levels of mispricing. This confirms that the impact the independent variables have on various levels of mispricing are significantly different across the mispricing distribution and supports our use of the QR to explore those differences.

Table 7.8: Tests of the equality of slope estimates across quantiles

Level of mispricing	Quantiles	F-Statistic	p-value
Highly overpriced vs underpriced	0.148 vs 0.889	10.59	0.000***
Overpriced vs fairly priced	0.446 vs 0.686	2.30	0.008***
Highly overpriced vs overpriced vs fairly priced vs underpriced	0.148 vs 0.446 vs 0.686 vs 0.889	10.49	0.000***

1. The table shows the F-statistics of the equality of slope estimates across the selected quantiles representing the levels of the first day returns.
2. Coefficients significant at the levels of 1%, 5% and 10% are marked by ***, ** and * respectively.

7.6 Conclusion

This chapter examines the determinants of mispricing of IPOs issued in Malaysia from 1995 to 2013. We find an overall lower level of mispricing, compared to the older studies in Malaysia but consistent with the recent studies (Younesi et al. 2012; Badru & Ahmad-Zaluki, 2018). The reduction in the magnitude of the mispricing indicates a movement towards pricing behaviour where issuers tend to maximise the amount of money raised from the IPOs. Further, as is the case in the last three empirical chapters, the distribution of the mispricing of Malaysian IPOs is skewed to the right, with 59.42% of the IPOs being overpriced and only 18.85% of the sample IPOs having above-average returns.

The findings provide new understandings about the mispricing of Malaysia IPOs. We find that there are various levels of mispricing for IPO returns i.e., highly overpriced, overpriced, fairly priced and underpriced IPOs. IPOs have different characteristics across the four levels of mispricing. We examine the relationships between the levels of mispricing and the independent variables using the OLS and QR approaches.

Overall, ex-ante uncertainty and the underwriter role are key determinants of mispricing in Malaysian IPOs. This finding is consistent with prior studies. The QR approach provides further details about the relationships between the independent variables across different levels of mispricing. With the exception of offer size, we find variations in the factors that explain the highly overpriced IPOs, compared to those that explain the underpriced IPOs. We also find that firms listed on the ACE market signal higher risk characteristics are more mispriced compared to the firms listed on the Main market. The theoretical implications that are developed based on the IPO process in the developed markets do not apply to Malaysia where the IPO process largely differs from the developed markets such as the US.

Chapter 8: Mispricing and Country-Level Institutional Framework

8.1 Introduction

The previous four chapters examine the impacts of firm-level factors on IPO mispricing in four sample markets – the US, Australia, China and Malaysia. Our findings suggest that IPO mispricing is an outcome of various firm-level characteristics as well as the institutional characteristics of the country where the firm goes public. The firm-level characteristics include the profile of the company, the characteristics of the offer, the profile of the intermediaries and entities such as underwriters and venture capitalists associated with the offer, the quality of disclosure made in the IPO prospectus, and the state of the market when the issue is made. The institutional characteristics of the country include the dominant method of pricing IPOs, regulatory restrictions and legal obligations a firm needs to abide by when going public, the extent of government intervention in secondary markets, and choice of listing exchange.

The mispricing of US IPOs is caused by large firm size, higher earnings per share forecast, higher retained ownership, VC backing, high market performance and volatility, and listing on NASDAQ. Whereas in Australia, mispricing is caused by younger age, smaller offer size, lower offer price, absence of an underwriter and high market performance. The Chinese IPOs have a different set of factors impacting their mispricing that include older age, high earnings forecast, smaller offer size, higher price, high market performance and volatility, time lapse between the offer and the listing date, and listing on SSE. Lastly, in Malaysia, the factors that significantly impact mispricing are smaller firm size, lower earnings forecast, higher offer price, higher reputable underwriters, higher market performance and low market volatility.

A recent body of literature suggests that, in addition to firm-level factors, the institutional framework of a country has a significant impact on IPO mispricing (Engelen & van Essen, 2010; Autore et al., 2014). La Porta et al. (1997) suggest that the country-level institutional quality affects a firm's ability to raise capital, as countries where the institutional framework offers poor investor protection will

have fewer companies going public. Another aspect of institutional quality, which is law enforcement, varies across countries. Countries with poor investor protection and law enforcement suffer in terms of financial development (King & Levine, 1993; La Porta et al., 1998; Rajan & Zingales, 1995). Hence, difficulty in raising capital and poor law enforcement add to the level of ex-ante uncertainty about an IPO.

In an environment where uncertainty is high, investors will require higher mispricing to compensate for the risk that they take when subscribing to an IPO. For example, firms operating in an environment with poor regulation of intellectual property are likely to underinvest in intangible assets, leading to lower value of the firm (Claessens & Laeven, 2003). A firm operating in a country that has poor rule of law and poor legal protection will face uncertainty about its post-issue operations and strategic decisions (such as investing in intellectual property), which negatively affects the value of the firm and increases uncertainty. Investors who subscribe to risky IPOs will therefore require higher mispricing. The uncertainty that is caused by a country's institutional quality is in addition to the level of uncertainty that is caused by firm-level factors. For example, firms with lower-quality underwriters are more mispriced due to higher firm-level ex-ante uncertainty about the value of the firm. However, a firm that has a lower quality underwriter and goes public in an environment with poor regulation quality and rule of law would be more mispriced than a firm with the same quality underwriter that goes public in an environment with better regulation quality and rule of law. This additional mispricing is a result of the ex-ante uncertainty caused by country-level factors.

In this chapter, we extend the examination of mispricing from a single-country level to a cross-country study to analyse the impacts of institutional quality and economic strength of a country on the mispricing of IPOs. We use control of corruption, government effectiveness, political stability, regulation quality, voice and accountability, and rule of law by Kaufmann et al. (2015) as measures of institutional quality. For economic strength, we use GDP per capita and GDP growth rate.

First, we find that the relationship that is established between the firm-level variables and the mispricing at an individual country level is robust in an

international setting. Consistent with previous studies (e.g. Boulton et al., 2010; Engelen & van Essen, 2010; Autore et al., 2014), our results support the view that ex-ante uncertainty contributes to mispricing. We show that IPOs in countries with lower levels of institutional quality are more mispriced. The reason is that lower levels of institutional quality increase ex-ante uncertainty about the value of the firm and thus the investors require less mispricing. Further, large economic size is found to reduce mispricing whereas higher economic growth increases mispricing.

8.2 A snapshot of mispricing across four countries

Table 8.1 provides a snapshot of the impacts each firm-level factor has across the four countries. Firm-level factors tend to impact mispricing differently in each of the sample countries. For example, size of the firm is found to increase mispricing in the US and decrease mispricing in Malaysia. Firm age reduces mispricing in Australia whereas it increases mispricing in China. This difference requires an explanation. Findings from developed markets suggest that the older a firm is, the greater the amount of historical information on pre-listing performance that is available to help investors arrive at a more accurate valuation of the equity and thus reduce ex-ante uncertainty and mispricing (Loughran & Ritter, 2002). However, in emerging economies, investors find older firms to be risky, which increases ex-ante uncertainty and requires higher mispricing (Lin et al., 1998). Consistent with Beatty and Welch (1996), we find that higher levels of retained ownership increase mispricing in the US but we do not find this to be a significant determinant of mispricing in the other three markets.

Offer price, which Allen and Faulhaber (1989) argues to be a signal by the issuer, impacts differently across the four markets. We find that a lower offer price reduces mispricing in Australia (Brennan and Hughes, 1991; Gygax and Ong, 2011) but increases mispricing in China and Malaysia (Chang et al., 2008). Beatty and Welch (1996) provide an explanation to this relationship, arguing that although lower offer price is a signal that the issue is of good quality (and should reduce mispricing), if a lower offer price disproportionately benefits riskier firms, investors might revise their perceptions of the firm's intrinsic riskiness, resulting in an opposite implication – that is, IPOs priced lower will be more mispriced. For China, this impact was more pronounced during the period when IPOs had fixed prices.

Table 8.1: Summary of the four countries firm-level variables

Variables	US	Australia	China	Malaysia
(Intercept)	-***	+***	+***	-
$logAssets_i$	+**	+	+	-*
$logAge_i$	-	-***	+***	-
EPS_i	+***	-	+***	-***
$RetOwn_i$	+*	+	+	+
$logOS_i$	+	-***	-***	+
IM_i	+	-	+	-
$InvOP_i$	-	-***	+***	+***
UMS_i	+	-**	-	+**
VC_i	+***	+	-	-
RF_i	+	+	+	-
$MP30_i$	+***	+***	+***	+**
$Exchange_i$	+***		-***	
$RelVol_i$	+***	-	+***	-**
$logLagDays_i$			+***	
$Board_i$				+

1. This table summarises the signs and significance of the firm-level variables across the four countries.

The variations in the impacts that firm-level variables have on mispricing across the four markets are not only limited to company and offer characteristics. Entities other than the issuer that provide issue certification (i.e. underwriters and VCs) also have varying impacts on mispricing in the four countries. We find the involvement of an underwriter reduces mispricing in Australia whereas the involvement of reputable underwriters increases mispricing in Malaysia (Paudyal et al., 1998). The involvement of a VC in the IPO process is found to increase mispricing in the US (Loughran and Ritter, 2004), where 39% of the IPOs are backed by VCs.

A finding that is common across four markets is the positive impact of market euphoria on the mispricing (Ritter 1984; Autore et al., 2014). Whereas volatility increases mispricing in the US and China, it decreases mispricing in Malaysia. This suggests that investors in the US and China require higher mispricing when IPOs are issued during period of volatility, whereas Malaysian investors tend to pay less for IPOs issued during the periods of high market volatility. The exchange at which the IPO is issued is also found to be a significant factor in explaining the direction of mispricing. In the US, firms listed in the NASDAQ are more mispriced, as these firms are mostly new technology ventures and are associated with higher uncertainty. In China, firms listing on the SSE tend to be riskier and requires more mispricing.

In summary, we provide insights into the impacts that firm-level factors have on mispricing. Overall, ex-ante uncertainty is the key driver that impacts mispricing. But, the magnitude and direction of the impact is determined by the country-level institutional framework.

8.3 Institutional framework and mispricing

A major finding of studies that examine the impacts of institutional quality on capital market performance is that better institutional quality reduces ex-ante uncertainty at the time of the IPO and leads to less mispricing. Engelen and van Essen (2010) argue that strong institutions reduce ex-ante uncertainty, since investors have more confidence that they are protected by laws against any expropriation by the controlling shareholder, and thus require less mispricing. Doidge, Karolyi and Stulz (2007) find that firms that operate in countries with poor corporate governance practices will not commit to better governance. In this regard, a better governance level limits the expropriation of private benefits by controlling shareholders. For example, controlling shareholders have access to day-to-day information about a company's operations, which they can use for their benefit at the cost of outside shareholders. Therefore, in a country with weaker investor protection, there will be higher ex-ante uncertainty at the time of IPO, and investors will require higher mispricing to subscribe to the IPO.

A country with strong institutional quality has both positive and negative effects on IPO mispricing. Strong institutions make it easy for firms to raise capital, while they also strengthen the position of the minority investors and reduce the entrepreneurs' control of their firm. Similarly, strong regulation quality and law enforcement make corporate disclosure more transparent. At the same time, strong regulation quality also exposes firms to the risk of losing value in the event of the firm making a loss. Therefore, issuers in countries with strong institutional quality who want to retain control over their firms have an incentive to price their IPOs lower, as setting a lower price will increase demand for the IPO shares and this will result in dispersed ownership and less monitoring by minority shareholders (Boulton et al., 2010).

The number of studies that have examined the effects of country-level factors on IPO mispricing is limited. Boulton et al. (2010) use various proxies, such as anti-

director rights, creditors' rights, efficiency of judicial system, anti-self-dealing, anti-self-dealing public enforcement, democracy, property rights, public enforcement and rule of law to examine the impacts of country-level corporate governance on IPO mispricing. Their findings suggest that countries that have higher levels of investor protection experience more mispricing. On the other hand, they find a negative and significant relationship between public enforcement and first day returns, suggesting that IPOs in countries where the regulators who monitor the stock exchange have more power experience less mispricing.

Using quality of financial reporting practices, enforcement of law, outside monitoring, level of economic development and public trust as proxies for institutional quality, Autore et al. (2014) find that country-level institutional quality is positively related to the first day returns of IPOs in developed markets. This relationship is absent for IPOs in emerging markets. In addition, they report that IPO mispricing is higher in countries whose quality of financial reporting score is above the median, but does not have any impact in countries whose financial reporting score is below the median. They further find that IPOs in countries where insider trading laws are enforced have higher first day returns than those in countries that do not enforce insider trading laws. Similarly, IPOs in countries with high public trust scores are more mispriced and vice versa. Lastly, countries that restrict ownership of non-financial companies by banks experience more mispricing. In contrast, Engelen and van Essen (2010) find that if a country has a strong legal framework this reduces ex-ante uncertainty and mispricing. They argue that a strong legal system reduces an issuer's cost of going public compared to what it would be for a firm in a country with a weaker legal system, and hence less mispricing is required.

The other important factor that impacts a firm's performance is the state of the economy in which a company is operating. Autore et al. (2014) posit that strong economies have strict laws which induce issuers to misprice their IPOs to reduce outside monitoring. Thus, higher mispricing is the consequence. On the other hand, Engelen and van Essen (2010) find that large economies are associated with less uncertainty and the IPOs in those countries display less mispricing. Similarly, Boulton et al. (2017) find an indirect relationship between size of the economy (measured as the log of GDP per capita) and IPO mispricing. Their study focuses

on the impact of country-level accounting conservatism[30] on IPO mispricing. They show that larger economies have higher levels of conservatism, and that higher levels of conservatism lead to less mispricing. On the other hand, IPOs in countries with higher levels of public trust scores are more mispriced and vice versa. This is because of the positive correlation between public trust and economic growth (La Porta et al., 1997) and because higher levels of public trust increase market participation as firms find it easy to go to public to raise equity (Guiso, Sapienza & Zingales, 2004).

Table 8.2: Definitions of explanatory variables

Variable	Definitions
$ContofCorr_i$	Control of corruption: includes perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as the "capture" of the state by elites and private interests (Kaufmann et al., 2015).
$GovtEff_i$	Government effectiveness; includes perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies (Kaufmann et al., 2015).
$PoliStab_i$	Political stability: includes perceptions of the likelihood that the government will be destabilised or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism (Kaufmann et al., 2015).
$RegQual_i$	Regulations quality: includes perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development (Kaufmann et al., 2015).
$VoiceAndAcct_i$	Voice and accountability: includes perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media (Kaufmann et al., 2015).
$RuleOfLaw_i$	Rule of law: includes perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence (Kaufmann et al., 2015).
log GDP / capita$_i$	Logarithm of gross domestic product per capita.
GDP growth$_i$	Annual percentage change in gross domestic product per capita.
$Ausi_i$	Dummy: if country is Australia then 1 otherwise 0
$China_i$	Dummy: if country is China then 1 otherwise 0
$Malaysia_i$	Dummy: if country is Malaysia then 1 otherwise 0
$TA.Z_i$	z-score of pre-IPO total assets

[30] Boulton et al. (2017) define conservatism as accounting practices in which the net book value of assets is systematically understated relative to market values.

Table 8.2 (continued)

Variable	Definitions
$logAge_i$	Logarithm of the firm's age in years calculated from the difference of the foundation year and the time of the IPO.
$EPS.Z_i$	z-score of earnings per share forecast provided in prospectus
$RetOwn_i$	Calculated as one minus the number of shares issued / total number of shares outstanding.
$OS.Z_i$	z-score of offer size (offer price x no. of shares offered)
IM_i	A dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers.
$OP.Z_i$	z-score of offer price
UMS_i	Underwriter's market share calculated through the capital raised by the underwriter in a year divided by capital raised by all the IPOs in that year.
VC_i	A dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise.
$RiskFactors_i$	The number of risk factors reported in the IPO prospectus.
$MP30_i$	pre-IPO 30 days performance of the market index where the stock is listed.
$RelVol_i$	Realised volatility of 30 days pre-IPO is calculated as the square root of $(252*\sum(\ln(PX_{t\text{-}i}/PX_{t\text{-}i\text{-}1}))^2 / N)$

1. The table provides definitions of the independent variables used in the study.

8.4 Method

Following the base model given in Equation (3.3), the empirical model for examining mispricing across countries is given in Equation (8.1). The model combines firm-level and country-level variables along with a set of control variables,

$$logRR_{i,t} = \alpha + \sum_{j=1}^{J} \beta_j X_{it}^{j} + \sum_{k=1}^{K} \beta_k X_{it}^{k} + \sum_{l=1}^{L} \beta_l X_{it}^{l} + \sum_{m=1}^{M} \beta_m X_{it}^{m} + \varepsilon_{i,t} \quad (8.1)$$

where the dependent variable is the log of first day returns calculated as in Equation (3.1); X_{it}^{j} refers to a set of firm-level explanatory variables; X_{it}^{k} refers to a set of country-level variables; X_{it}^{l} denotes a set of country dummies to control country effects and X_{it}^{m} denotes a set of year dummies used to control time effects. The definitions of the explanatory variables are stated in Table 8.2. It is important to mention that the data for each country is collected in its local currency (where applicable). Therefore, for consistent comparison, we transform the variables denominated in local currencies into z-scores.

8.5 Sample characteristics

8.5.1 Descriptive statistics by country

The magnitude of mispricing as well as the characteristics of the firms going public vary as shown in Panel A of Table 8.3. Across the four countries, China has the highest mispricing followed by the US, Australia and Malaysia. One might expect that developed markets such as the US and Australia would exhibit lower mispricing; however, it is Malaysia that has the lowest level of the mispricing. Chinese IPOs are the largest in size and Malaysian IPOs are the smallest. In each country, the companies that go public have different ages. US companies are found to be the oldest and the Australian ones are the youngest. We further see that firms in China and Malaysia retain higher proportions of ownership than those in the US and Australia.

The dominant method of going public in Australia and Malaysia is the fixed price method, whereas the US issuers uses the book building method to price IPOs. The Chinese IPO market has used a combination of the two methods. The fixed price method was used until December 2004 and the book building method was adopted in January 2005. The underwriter reputation measured by underwriters' market share suggests there is a higher level of reputable underwriter involvement in US and Malaysian IPOs, whereas reputable underwriters have the least involvement with Australia IPOs. Similarly, the practice of involving a VC in an IPO is most common in US IPOs and least common in Malaysia and Australia. The highest average number of reported risk factors is found in China, whereas the smallest number is found in the US and Malaysia. Lastly, an examination of the markets where the IPOs are listed suggests that the Chinese market has less euphoria but higher volatility at the times when the highest number of firms is going public. The Australian markets are exuberant but are the least volatile. The Malaysian market shows the least (approximately) movement in the market, in terms of both performance and volatility. Malaysian IPOs have the least returns among the four countries.

Table 8.3: Variable means for each country

Panel A: Means of firm-level variables by country				
Variables	**Australia**	**China**	**Malaysia**	**US**
First Day Returns (%)	25.51%	112.10%	1.80%	34.90%
Total Assets (USD million)	118.50	1506.60	47.95	841.26
Age (years)	4.99	6.10	6.01	15.30
EPS (USD)	1.56	0.08	0.37	0.27
Offer Size (USD million)	30.96	144.15	80.29	119.24
Retained Ownership (%)	57.50%	72.90%	72.30%	11.50%
Inverse of Offer Price	4.58	1.00	5.08	0.08
Issue Method	0.98	0.45	0.96	0.20
UMS	0.01	0.04	0.10	0.07
VC	0.02	0.18	0.03	0.39
No. of Risk Factors	13.32	28.30	18.58	14.20
$MarketPerformance_{t-30}$ (%)	7.29%	1.80%	0.60%	2.14%
$Realised\ Volatility_{t-30}$ (%)	12.84%	27.47%	12.90%	17.49%

Panel B: Means of country-level variables by country				
Variables	**Australia**	**China**	**Malaysia**	**US**
Control of corruption	1.99	-0.46	0.30	1.53
Government effectiveness	1.77	0.00	1.06	1.69
Political stability	0.97	-0.46	0.28	0.63
Regulation quality	1.66	-0.25	0.55	1.57
Voice and accountability	1.45	-1.51	-0.35	1.27
Rule of law	1.75	-0.41	0.51	1.52
GDP / capita p.a. (USD)	38,782.66	2,857.59	5,809.60	38,521.27
log GDP / capita	10.49	7.65	8.61	10.54
GDP growth p.a. (%)	3.30%	9.80%	5.70%	3.10%

Panel C: No. of IPOs across markets and time					
Year	**Total**	**Australia**	**China**	**Malaysia**	**US**
1995	327	12	18	8	289
1996	566	11	182	17	356
1997	447	24	194	13	216
1998	243	15	95	7	126
1999	319	33	96	12	178
2000	387	60	133	28	165
2001	165	29	75	14	47
2002	204	38	71	40	55
2003	210	54	67	45	44
2004	376	92	100	63	121
2005	303	96	15	62	130
2006	327	126	67	9	125
2007	433	179	125	3	126
2008	168	54	77	20	17
2009	174	31	99	8	36
2010	547	76	347	28	96
2011	483	96	282	18	87
2012	310	43	154	10	103
2013	182	26	1	14	141
No. of IPOs	6,171	1,095	2,199	419	2,458

1. The table presents the sample specifications across the four countries. Panel A reports the means of firm-level independent variables across the four countries. Panel B reports country-level independent variables across the four countries. Panel C reports the frequency of firms going public in the four countries over the period from 1995 to 2013.

Table 8.3 (continued)

2. The names and listing dates of the 8069 IPOs in Australia, China, Malaysia and the US were obtained from Morning Star, SDC Platinum New Issues Database and Bursa Malaysia. The offer prices of the IPOs and the independent variables are primarily obtained from IPO prospectuses sourced from Thomson One Banker, the SDC Platinum New Issues Database, the Australian Securities Exchange website, the Bursa Malaysia website and Jay Ritter's IPO data. The daily prices of the stocks included in our sample, the ASX All Ordinaries Index, the Shanghai Stock Exchange A-Shares Index, the Shenzhen Stock Exchange A-Shares Index, the FTSE Bursa Malaysia KLCI Index, the NYSE Composite Index and the NASDAQ Composite Index are obtained from Datastream. For country-specific variables, Worldwide Governance Indicators developed by Daniel Kaufmann and Aart Kraay were obtained from the World Bank's governance indicators. The data on GDP per capita and GDP growth rate were sourced from the World Development Indicators available from the World Bank's data catalogue. The time series exchange rates, to convert offer price, total assets, offer size and EPS values from home currency to US Dollars, were obtained from Datastream.

3. The first day returns were calculated as (First day closing price – Offer price)/Offer price. Assets are pre-IPO total assets. Age is the firm's age in years calculated at the time of IPO from date of incorporation. EPS is the forecast earnings per share given in the prospectus. Retained Ownership is one minus the number of shares issued over total number of shares outstanding. Offer Size is measured as the final offer price multiplied by the number of shares offered. Issue Method is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. Inverse offer price is one divided by final offer price per share. Underwriter Market Share is calculated as the sum of total capital raised in IPOs by the underwriter in a year *t*, divided by the total capital raised by all the IPOs in the year *t*. Venture Capitalist is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. No. of Risk Factors measures the risks reported in the IPO prospectus. $\text{MarketPerformance}_{t-30}$ is the pre-IPO 30-day performance of the market index where the IPO is listed. $\text{Realised Volatility}_{t-30}$ is the 30-day pre-IPO volatility of market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$. Control of corruption, government effectiveness, political stability, regulation quality, voice and accountability and rule of law are six measures of institutional quality by Kaufmann et al. (2015). GDP per capita is a measure of economic size in USD. GDP growth rate is the percentage change in GDP of a country in one year. log GDP / cap is the natural logarithm of one plus GDP per capita.

4. All figures in monetary values are in USD.

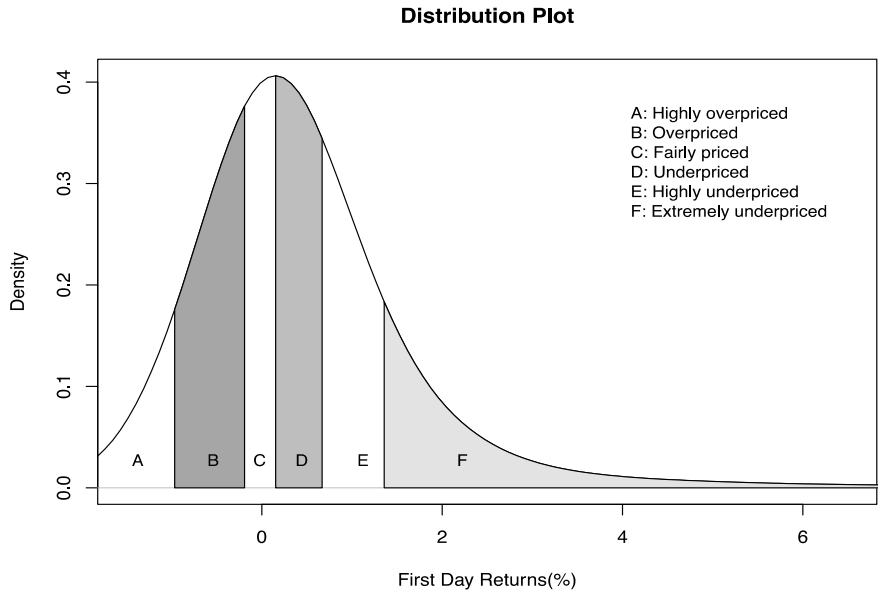
Panel B of Table 8.3 reports the means of the country-level variables across the four countries. The first six variables are measures of institutional quality at the country level by Kaufmann et al. (2015) where a high score indicates stronger institutional quality based on the means for the six variables. Australia would appear to have the highest institutional quality, followed by the US, Malaysia and China. The lowest score for control of corruption for China is consistent with the notion that IPOs in countries with high levels of corruption experience high mispricing (Jenkinson & Ljungqvist, 2001, p. 39). This observation is further supported by Tian (2011). The measures of economic development show variation across each of the sample country. For example, GDPs per capita for each country show that Australia has the highest GDP per capita while China has the lowest. GDP growth rate is higher for the emerging markets and lower for the developed markets. However, the change in the growth rate is more stable for the developed markets (i.e. Australia and the US), and volatile for the emerging markets (i.e. China and Malaysia). We also find a positive correlation between the variables representing institutional quality and economic strength.

Panel C of Table 8.3 shows trends in IPO volumes across markets and time. There is considerable variation in the number of firms going public over the years. For example, there are two peaks, in terms of the number of firms going public, in our sample period. One takes place during the period from 1996 to 1999 and the other occurs during the period from 2010 to 2012. The highest number of public offerings was made in the year 1996 and the lowest in 2008. Further, consistent with the phenomenon of hot issues markets as explained by Ritter (1984), there is a positive correlation between mispricing and IPO volume.

8.5.2 Levels of mispricing

The average mispricing across the four countries is 58.51%. This is significantly higher than the average of 24.97% reported in Engelen and van Essen (2010). This is because of the large mispricing observed in Chinese IPOs. The average mispricing of the US and Australian IPOs is 32.01% which is close to the 30.1% reported by Autore et al. (2014) for developed markets. The distribution plot of mispricing across the whole sample is shown in Figure 8.1.

Figure 8.1: Distribution plot showing the levels of mispricing across the whole sample



Consistent with the common observations in the literature and the findings in the previous empirical chapters, the mispricing distribution of the whole sample is skewed to the right, with a huge difference between the mean (58.51%) and the median (11.54%). Following the same procedure used in the previous chapters, we

divide the mispricing distribution into three categories with respect to the sign of their returns. There are 1684 IPOs with negative returns which we sub-divide into two equal groups of highly overpriced (the top 13.6% of the sample where the IPOs are ranked from the most overpriced to the most underpriced) and overpriced IPOs (ranked observations from 13.6% to 27.3%). We have 332 IPOs with zero returns, referred to as fairly priced IPOs (ranked observations from 27.3% to 32.7%). Lastly, there are 4155 IPOs with positive returns which we sub-divide into three equal groups of underpriced (ranked observations from 32.7% to 55.1%), highly underpriced (ranked observations from 55.1% to 77.6%) and extremely underpriced IPOs (ranked observations from 77.6% to 100%).[31]

The means of the mispricing sub-ranges and the corresponding means of the firm-level independent variables are reported in Panel A of Table 8.4. The means of the mispricing levels are influenced by concentration of the four countries across the six groups as shown in Panel B of Table 8.4. The majority of the highly overpriced IPOs (71.50%) are the US IPOs which are only 24.50% of the US sample. Whereas 26.36% of the highly overpriced IPOs are Malaysian IPOs which is approximately 53% of the Malaysian sample. The cluster of the three sub-categories of the underpriced IPOs are dominated by Chinese IPOs (49.18%). However, among the extremely underpriced IPOs 73.06% are from China. Malaysia has the least concentration in the three-categories of the underpriced IPOs followed by Australia.

The firms in the six levels of mispricing exhibit varying characteristics. The highly overpriced firms are the smallest, oldest, provide highest earnings forecasts in their prospectus, have smaller offer sizes and higher prices. The highly overpriced IPOs are also found to be certified by highly reputable underwriters and have high involvement of venture capitalists. These firms report fewer risk factors in their IPO prospectus and go public in periods of negative market performance. At the other end of the distribution, the extremely underpriced firms are the largest. These firms

[31] The distribution of the whole sample of returns is divided into three categories i.e. IPOs with negative returns, IPOs with zero returns and IPOs with positive returns. There are 1684 IPOs with negative returns which are further divided into two equal sub-categories: highly overpriced IPOs and overpriced IPOs. There are 4155 IPOs with positive returns which are further divided into three subcategories; underpriced IPOs, highly underpriced IPOs and extremely underpriced IPOs. Finally, there are 332 IPOs with close to zero returns referred to as fairly priced IPOs. The mid-points of these sub-categories are selected as the reference points. The mid-points for the highly overpriced and overpriced IPOs are 0.068 and 0.2045 respectively. The mid-point of the range for underpriced IPOs is 0.439, that for highly underpriced IPOs is 0.6635 and that for extremely underpriced IPOs is 0.888. Lastly, the mid-point for the fairly priced IPOs is 0.30.

Table 8.4: Whole sample means by the extent of mispricing

Panel A: Means of firm-level variables by the extent of mispricing						
Variables	**Highly overpriced**	**Overpriced**	**Fairly priced**	**Underpriced**	**Highly underpriced**	**Extremely underpriced**
	0-0.136	**0.136-0.273**	**0.273-0.327**	**0.327-0.551**	**0.551-0.776**	**0.776-1**
First Day Returns (%)	-57.22%	-3.78%	0.00%	6.57%	42.83%	148.46%
Total Assets (USD mil.)	102.52	222.99	394.36	1360.31	1489.17	2935.99
Age (years)	13.49	8.94	9.52	11.44	9.26	5.98
EPS (USD)	1.24	0.94	0.56	0.84	0.32	0.34
Offer Size (USD mil.)	93.03	182.58	86.25	220.42	182.13	79.71
Retained Ownership (%)	30.48%	44.40%	32.63%	40.74%	50.28%	59.33%
Inverse of Offer Price	1.26	2.52	2.61	1.58	0.86	1.53
Issue Method	0.86	0.75	0.86	0.73	0.53	0.74
UMS	0.07	0.04	0.05	0.04	0.05	0.04
VC	0.25	0.15	0.17	0.22	0.28	0.20
No. of Risk Factors	15.52	16.49	15.85	16.44	21.87	24.72
$MarketPerformance_{t-30}$ (%)	-1.74%	-20.97%	-10.98%	5.14%	10.84%	17.63%
Realised volatility $_{t-30}$ (%)	16.30%	15.60%	9.00%	16.6%	22.10%	26.80%
Total no. of IPOs	842	842	332	1,385	1,385	1,385

Panel B: Country-wise breakdown of IPOs in each level of mispricing						
	Highly overpriced	**Overpriced**	**Fairly priced**	**Underpriced**	**Highly underpriced**	**Extremely underpriced**
	0-0.136	**0.136-0.273**	**0.273-0.327**	**0.327-0.551**	**0.551-0.776**	**0.776-1**
No. of the US IPOs	602	272	186	661	495	242
No. of Australian IPOs	-	406	58	446	86	99
No. of Chinese IPOs	18	137	-	258	774	1,012
No. of Malaysia IPOs	222	27	88	20	30	32

Table 8.4 (continued)

Panel C: Means of country-level variables by the extent of mispricing

Variables	**Highly overpriced**	**Overpriced**	**Fairly priced**	**Underpriced**	**Highly underpriced**	**Extremely underpriced**
	0-0.136	**0.136-0.273**	**0.273-0.327**	**0.327-0.551**	**0.551-0.776**	**0.776-1**
Control of corruption	1.20	1.36	1.28	1.27	0.39	0.13
Government effectiveness	1.50	1.43	1.55	1.40	0.75	0.42
Political stability	0.55	0.54	0.57	0.48	0.03	-0.07
Regulation quality	1.28	1.28	1.32	1.25	0.54	0.22
Voice and accountability	0.81	0.83	0.87	0.77	-0.33	-0.74
Rule of law	1.20	1.29	1.29	1.22	0.44	0.10
GDP per capita p.a. (USD)	27,507.40	33,782.54	31,160.79	32,704.22	17,907.81	99,34.99
log GDP / capita	9.923	10.173	10.08	10.10	9.00	8.01
GDP growth p.a. (%)	0.049	0.041	0.037	0.044	0.069	0.081

1. The data sources are consistent with Table 8.3.
2. The table breaks down the levels of the first day returns based on the magnitude of mispricing, where figures of 0 to 0.136 refer to highly overpriced IPOs, 0.136 to 0.273 refer to overpriced IPOs, 0.273 to 0.327 refer to fairly priced, and 0.327 to 0.551, 0.551 to 0.776 and 0.776 to 1 refer to underpriced, highly underpriced and extremely underpriced IPOs respectively.
3. The first day returns are calculated as (First day closing price – Offer price)/Offer price. Assets are pre-IPO total assets. Age is the firm's age in years calculated at the time of IPO from date of incorporation. EPS Earnings forecasts are provided in the IPO prospectus. Retained Ownership is one minus the number of shares issued over total number of shares outstanding. Offer Size is measured as the final offer price multiplied by the number of shares offered. Issue Method is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. Inverse offer price is one divided by final offer price per share. UMS is the underwriter's market share calculated through the capital raised by the underwriter in a year divided by capital raised by all the IPOs in that year. Venture Capitalist is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. No. of Risk Factors measures the risks reported in the IPO prospectus. $MarketPerformance_{t-30}$ is the pre-IPO 30-day performance of the market index where the stock is listed. Realised $Volatility_{t-30}$ is the 30-day pre-IPO volatility of market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$. Control of corruption, government effectiveness, political stability, regulation quality, voice and accountability and rule of law are six measures of institutional quality by Kaufmann et al. (2015). GDP per capita is a measure of economic size in USD. GDP growth rate is the percentage change in GDP of a country in one year. log GDP / cap is the natural logarithm of one plus GDP per capita.
4. All figures in monetary values are in USD.

are the youngest (Loughran and Ritter, 2004), have smaller offer sizes (Michaely and Shaw, 1994) and retain higher proportions of the shares at the time of their IPOs (Beatty and Welch, 1996; Bradley, Jordan, Yi & Roten, 2001). The IPOs that are extremely underpriced provide lower earnings forecasts (Lev and Penman, 1990) and report more risk factors in their prospectus (Gygax and Ong, 2011). These firms are underwritten by financial institutions that are less reputable than those associated with other firms, and they have more involvement from venture capitalists (Meigginson and Weiss, 1991; Loughran and Ritter, 2004). These firms are found to go public during periods of high market performance and market volatility (Paudyal et al., 1998; Autore et al., 2014). The characteristics of the extremely underpriced firms tend to increase ex-ante uncertainty and would require higher mispricing.

The overall observation is that the means of the key variables vary across the levels of IPO mispricing. For example, the pre-IPO assets (measured in millions of US dollars) increase as the IPO returns increase. The IPOs of the smallest firms tend to be overpriced while those of the larger firms tend to be underpriced. The age of the firm at the time of going public is inversely related to the IPO returns, which means that younger firms have higher returns. Similarly, the earnings forecast figure has an inverse relationship with IPO returns, which means that the firms that provide higher earnings forecasts have negative returns. The means of market performance and market volatility suggest that issues that go public during periods of high market performance are underpriced, whereas issues that go public during periods of negative market performance are overpriced. Further, higher market volatility is associated with higher mispricing, such that when market volatility is above average, IPOs experience mispricing. Below average market volatility is associated with overpriced IPOs. Fairly priced IPOs are associated with the least volatile markets.

Panel C of Table 8.4 reports the means of country-level variables for the different groups of mispriced IPOs. The means of the first six variables, that reflect a country's institutional quality, show that the highest scores are related to the fairly priced IPOs. However, the second-highest scores are associated with the IPOs with negative returns, and the lowest scores are associated with highly underpriced and extremely underpriced IPOs. A similar pattern is observed for the set of variables

that capture the economic strength of a country. The lowest scores for GDP per capita are associated the IPOs that are highly underpriced and extremely underpriced, whereas higher levels of economic growth (GDP growth rate) are associated with higher levels of first day returns.

8.6 Results and discussion

8.6.1 OLS and median regression estimates

We start our empirical analysis by estimating the effect of country-level institutional quality and economic strength on the mispricing of the whole sample using the OLS and median regression approaches. The results are reported as Model 1 to Model 6 in Table 8.5. Model 1 reports the OLS estimates of Kaufmann et al.'s (2015) institutional quality measures. This relation is reflected in the significant and negative coefficients for four out of the six variables ranging from -0.2678 for political stability to -0.4532 for control of corruption.

The significantly negative coefficient of control of corruption suggests that IPOs in countries with less control of corruption are more mispriced. This is consistent with the hypothesis that higher ex-ante uncertainty leads to higher mispricing. This is because persistent corruption increases uncertainty by impeding firm growth, reducing productivity and increasing inefficiency (e.g. Ades & Tella, 1997; Athanasouli & Goujard, 2015; Dal Bó & Rossi, 2007). Thus, increased corruption increases information asymmetry and uncertainty, leading to higher mispricing (Jenkinson & Ljungqvist, 2001; Tian, 2011). The negative estimate for political stability (-0.2678) suggests that an increase of one standard deviation in a country's political stability score will result in a decrease of 26.78% in first day IPO returns.

The variable that has a significantly positive relationship with the first day IPOs returns is rule of law (1.8222). This suggests that IPOs in countries with a stronger rule of law experience higher underpricing. This implies that in countries where laws are strong, IPOs tend to be more mispriced. This is consistent with Tinic (1988) who finds that issuers misprice to reduce litigation risk. While mispricing and litigation are both costs to the issuers and underwriters, there is a trade-off between reducing litigation risk and increasing offer proceeds. Hughes and Thakor (1992) postulate that issuers and underwriters tend to minimise litigation risk.

Table 8.5: OLS and median regression estimates

Variables	OLS	Median QR	OLS	Median QR	OLS	Median QR
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
(Intercept)	-0.2012	0.2791	4.9954***	3.7673***	2.3593**	3.9602***
$ContofCorr_i$	-0.4532**	0.2128**			-0.4901**	-0.1606*
$GovtEff_i$	-0.3582**	-0.4501***			0.0151	0.4061***
$PoliStab_i$	-0.2678**	0.0475			-0.4077***	-0.2874***
$RegQual_i$	-0.3159*	-0.0910			-0.2834	0.2021**
$VoiceAndAcct_i$	-0.5747	-0.5825**			-0.3219	0.0935
$RuleOfLaw_i$	1.8222***	0.6466***			1.7150***	0.4604***
GDPGrowth			5.1550***	3.6125***	4.8241***	3.2967***
logGDP/Capita			-0.5275***	-0.3831***	-0.3295***	-0.5288***
$Ausi_i$	0.9053***	-0.0077	0.5771***	-0.0267	0.8245***	-0.0002
$China_i$	0.4732	-0.2937	-1.1797***	-0.9416***	0.0793	0.2505
$Malaysia_i$	-0.1848	-0.6232*	-1.1828***	-1.0792***	-0.4787	-0.5265*
$TA.Z_i$	0.0039	0.0040	0.0007	-0.0009	0.0027	0.0008
$logAge_i$	0.0219*	-0.0041	0.0335***	0.0023	0.0267**	0.0040
$EPS.Z_i$	0.0201	0.0211***	0.0244**	0.0237***	0.0184	0.0164***
$RetOwn_i$	-0.0816	0.0319	-0.0897	0.0211	-0.0913	0.0133
$OS.Z_i$	-0.0641***	-0.0153*	-0.0694***	-0.0289***	-0.0676***	-0.0324***
IM_i	0.0069	0.0614***	-0.1059**	0.0038	-0.0175	0.0114
$OP.Z_i$	-0.1337***	-0.0879***	-0.1169***	-0.0596***	-0.1275***	-0.0602***
UMS_i	0.0587	0.0832	0.1003	0.1049	0.0569	0.1137*
VC_i	0.0967***	0.0238**	0.1011***	0.0195**	0.1008***	0.0313***
$RiskFactors_i$	0.0042**	0.0014**	0.0032*	0.0013**	0.0039**	0.0009
$MP30_i$	0.0129***	0.0094***	0.0162***	0.0101***	0.0138***	0.0095***
$RelVol_i$	0.3975***	0.0708	0.1628	0.0463	0.3367**	0.0049
YearDummies	Yes	Yes	Yes	Yes	Yes	Yes
$Adj.R^2$ / R^1	0.1822	0.1622	0.1855	0.1693	0.1899	0.1721

Table 8.5 (continued)

1. The data sources are consistent with Table 8.3.
2. Estimated results are from Equation 8.1. The dependent variable is the log of one plus (First day closing price – Offer price)/Offer price. Control of corruption, government effectiveness, political stability, regulation quality, voice and accountability and rule of law are six measures of institutional quality used by Kaufmann et al. (2015). GDP growth rate is the percentage change in GDP of a country in one year. log GDP / cap is the natural logarithm of one plus GDP per capita. *Ausi* is a dummy with a value of 1 if the country is Australia and otherwise 0. *China* is a dummy with a value of 1 if the country is China and otherwise 0. *Malaysia* is a dummy with a value of 1 if the country is Malaysia and otherwise 0. *TA.Z* is the z-score of pre-IPO total assets. $LogAge_i$ is the logarithm of the firm's age in years calculated at the time of IPO from date of incorporation. $EPS.Z_i$ is the z-score of the forecast earnings per share given in the prospectus. $RetOwn_i$ is calculated as one minus the number of shares issued over total number of shares outstanding. $OS.Z_i$ is the z-score of offer size which is measured as the final offer price multiplied by the number of shares offered. IM_i is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. $OP.Z_i$ is the z-score of one divided by final offer price per share. UMS_i is calculated as the sum of total capital raised in IPOs by the underwriter in a year *t*, divided by the total capital raised by all the IPOs in the year *t*. VC_i is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. RF_i is the number of risk factors reported in the IPO prospectus. $MP30_i$ is the pre-IPO 30-day performance of the market index where the stock is listed. $RelVol_i$ is the 30-day pre-IPO volatility of market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$
3. Coefficients significant at the levels of 1%, 5% and 10% are marked by ***, ** and * respectively.
4. *Adjusted* R^2 is the goodness of fit measure for OLS and R^1 is the goodness of fit measure for QR based on Koenker and Machado (1999).

This is because litigation is not only costly in itself but also damages the underwriter's reputation and regular investors' confidence in the underwriter. This finding also supports Boulton et al. (2010) who suggest that in countries with higher institutional quality, the issuers tend to underprice more in order to maintain their control of the firm. The median regression results of Model 2 show similar results to Model 1, with a change in sign from negative to positive for control of corruption. However, the combined score of the six institutional factors (results not reported) show that overall, good institutional quality reduces mispricing (Doidge et al., 2007; Engelen & van Essen, 2010). This is the result in both the OLS and the median regression estimates.

Next, we examine the impact of a country's economic strength on first day IPO returns. We take two indicators to measure the strength of the economy: GDP per capita (measured in USD) as a measure of economic size, and GDP growth rate as a measure of economic growth. The OLS and median regression results for the two variables are reported in Model 3 and Model 4 of Table 8.5. The coefficient of GDP growth (Model 3) is positive and significant at the 5% level, suggesting that higher growth in GDP increases mispricing. The coefficient of *logGDP/capita* suggests that size of the economy is negatively correlated with the level of mispricing. Model 4 confirms the findings of Model 3, where the coefficients of GDP growth and *logGDP/capita* are positive and negative, respectively. The positive coefficient of GDP growth and negative coefficient of GDP per capita suggest that, when these variables are combined, mispricing decreases in small growing economies whereas it increases in large growing economies.

To examine the combined effect of all the country-level variables (institutional quality and economic strength) on IPO mispricing we regress the eight variables together. The OLS and median regression results are reported in Model 5 and Model 6 of Table 8.5. The combined model confirms the results of our previous findings, suggesting that higher institutional quality and larger economic size reduces mispricing whereas higher economic growth increases mispricing. However, we see slight variations in significance, size and sign between the coefficients of Model 5 and Model 6. The two variables that show a change in sign and significance are government effectiveness and regulation quality (compare Model 6 with Model 5 as well as with Model 1 and Model 2). How do we interpret these results? The

answer comes from Boulton et al. (2010) and Autore et al. (2014). In countries with high-quality policy development and implementation, and high regulation quality that protects shareholders, issuers misprice more at the margin to create enough dispersed ownership so that they can retain their control on the firm post-IPO.

It is important to note that both the OLS and the median QR methods examine central regions of the mispricing distribution – that is, the mean and the median. They do not examine the relationships between mispricing and independent variables in the non-central regions. Since our mispricing distribution comprises various levels of IPO returns, in the next subsection, we use the QR method to examine the relationships between levels of mispricing and country-level and firm-level explanatory variables.

8.6.2 QR estimates

We examine the impacts of country-level institutional quality and economic strength across the levels of mispricing by taking the mid-points of the distribution sub-ranges described in Table 8.4 (see footnote 30) as reference points for each level of mispricing, and we estimate it the impact using the QR method. The QR coefficients of each level of mispricing are reported in Table 8.6.

The overall results match expectations while providing further insights into how a combination of the country-level and firm-level factors explains various levels of mispricing. The factors that increase the mispricing of the highly overpriced IPOs are government effectiveness and rule of law, whereas better regulation quality reduces the mispricing of the highly overpriced IPOs. On the other hand, the institutional factor that increases the mispricing of the extremely underpriced IPOs is rule of law, whereas political stability and voice and accountability reduce the mispricing of the extremely underpriced IPOs. For the fairly priced IPOs, control of corruption and political stability reduce mispricing, whereas government effectiveness, regulation quality and rule of law increase mispricing.

The observed impact that institutional quality has on levels of mispricing suggests that country-level institutional quality explains the mid-region of mispricing distribution (fairly priced and underpriced IPOs) but does not adequately explain the extreme levels of mispricing (i.e. highly overpriced and extremely underpriced

Table 8.6: QR estimates by levels of mispricing

Variables	**Highly overpriced**	**Overpriced**	**Fairly priced**	**Underpriced**	**Highly underpriced**	**Extremely underpriced**
	0.068	**0.204**	**0.30**	**0.439**	**0.663**	**0.888**
(Intercept)	5.5922**	4.0196***	3.6647***	3.6894***	4.0704***	2.1630**
ContofCorr$_i$	-0.6922	-0.4602***	-0.2553**	-0.2515**	-0.2144*	-0.4667
GovtEff$_i$	1.1965**	0.4466	0.5024***	0.4318***	0.3777	-0.0573
PoliStab$_i$	0.1979	-0.4539***	-0.3412***	-0.3208***	-0.2854***	-0.7598***
RegQual$_i$	-1.0884**	0.1057	0.2808***	0.2332**	0.2156*	-0.1978
VoiceAndAcct$_i$	0.1163	0.2467	0.0478	0.3209	-0.1005	-1.4832**
RuleOfLaw$_i$	1.0510*	0.8240***	0.5209***	0.4321***	0.7281***	2.7567***
GDPGrowth	2.2369	3.2868***	3.1784***	3.3417***	4.7605***	7.8842***
logGDP/Capita	-0.8718***	-0.6043***	-0.5387***	-0.5217***	-0.5365***	-0.2248
Ausi$_i$	1.1477***	0.2006**	0.0111	-0.0287	0.1339	1.6339***
China$_i$	0.5621	0.5013	0.3436	0.7215	0.0219	-1.5822
Malaysia$_i$	-0.9761	-0.7075*	-0.7179**	-0.3315	-0.5865	-1.1283
TA.Z$_i$	0.0416	0.0246	0.0002	0.0036	0.0112**	-0.0075
logAge$_i$	0.0565***	0.0255***	0.0088*	0.0016	0.0034	0.0058
EPS.Z$_i$	0.0345*	0.0219***	0.0201***	0.0245***	0.0184***	0.0154
RetOwn$_i$	-0.3366***	-0.0902*	-0.0561*	-0.0011	0.0127	0.0399
OS.Z$_i$	-0.3228***	-0.0947***	-0.0412	-0.0297***	-0.0281***	-0.0253***
IM$_i$	0.1282	0.0254	0.0312*	0.0129	0.0074	-0.0806*
OP.Z$_i$	-0.2627***	-0.1213***	-0.0963***	-0.0710***	-0.0577***	-0.0834***
UMS$_i$	-0.5301**	-0.0451	0.0192	0.1065	0.2187***	0.4033***
VC$_i$	0.0635***	0.0302***	0.0145	0.0157	0.0542***	0.0826***
RiskFactors$_i$	0.0007	0.0012**	0.0005	0.0006	0.0011*	0.0049***
MP30$_i$	0.0084**	0.0086***	0.0087***	0.0096***	0.0125***	0.0558***
RelVol$_i$	0.3502***	0.1326*	-0.0207	-0.0091	0.0078	0.2801*
YearDummies	Yes	Yes	Yes	Yes	Yes	Yes
R^1	0.2672	0.1526	0.1369	0.1607	0.1936	0.1753

Table 8.6 (continued)

1. The data sources are consistent with Table 8.3.
2. Table provides QR estimates for the mid-points of the sub-ranges defined in Table 8.4.
3. Estimated results are from Equation 8.1. The dependent variable is the log of one plus (First day closing price – Offer price)/Offer price. Control of corruption, government effectiveness, political stability, regulation quality, voice and accountability and rule of law are six measures of institutional quality used by Kaufmann et al. (2015). GDP growth rate is the percentage change in GDP of a country in one year. log GDP / cap is the natural logarithm of one plus GDP per capita. *Ausi* is a dummy with value of 1 if the country is Australia and otherwise 0. *China* is a dummy with a value of 1 if country is China and otherwise 0. *Malaysia* is a dummy with a value of 1 if the country is Malaysia and otherwise 0. *TA.Z* is the z-score of pre-IPO total assets. $LogAge_i$ is the logarithm of the firm's age in years calculated at the time of IPO from date of incorporation. $EPS.Z_i$ is the z-score of the forecast earnings per share given in the prospectus. $RetOwn_i$ is calculated as one minus the number of shares issued over total number of shares outstanding. $OS.Z_i$ is the z-score of offer size which is measured as the final offer price multiplied by the number of shares offered. IM_i is a dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offers. $OP.Z_i$ the z-score of one divided by final offer price per share. UMS_i is calculated as the sum of total capital raised in IPOs by the underwriter in a year *t*, divided by the total capital raised by all the IPOs in the year *t*. VC_i is a dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. RF_i is the number of risk factors reported in the IPO prospectus. $MP30_i$ is the pre-IPO 30-day performance of the market index where the stock is listed. $RelVol_i$ is the 30-day pre-IPO volatility of market index calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$.
4. Coefficients significant at the levels of 1%, 5% and 10% are marked by ***, ** and * respectively.
5. R^1 is the goodness of fit measure for QR based on Koenker and Machado (1999).

IPOs). The same is true for the coefficients of the economic variables which show that high GDP growth increases the level of mispricing (except for highly overpriced IPOs) while GDP per capita reduces the level of mispricing (except for extremely underpriced IPOs). It is the firm-level factors that explain the extreme levels of mispricing. This indicates that moderate levels of mispricing are driven by the institutional quality of the country in which the firm goes public as well as the firm characteristics, while the extreme levels of mispricing are primarily driven by firm characteristics. For example, underwriter reputation has a significant negative impact on highly overpriced IPOs, whereas it has a significantly positive impact on highly underpriced and extremely underpriced IPOs. At the same time, involvement of VCs increases the mispricing of both highly overpriced and overpriced IPOs, as well as highly underpriced and extremely underpriced IPOs. This indicates that entities involved in the IPO (underwriter and VC) drive extreme levels of mispricing more than the environment of the country. IPOs which are underwritten by reputable underwriters and have VC involvement tend to be more mispriced (How et al., 1995; Dolvin, 2005; Loughran & Ritter, 2004).

Similarly, market volatility has a more pronounced impact on the extreme levels of mispricing than it has on the mid-levels of mispricing. On the other hand, the variables that have a consistent impact across the levels of mispricing are offer size (Michaely & Shaw, 1994; Dimovski & Brooks, 2004), offer price (Beatty and Welch, 1996; Guo and Brooks, 2008) and market performance (Autore et al., 2014).

Another important finding relates to the impact that the pricing mechanism has on mispricing. We find that across countries, book built IPOs tend to be more fairly priced whereas fixed priced IPOs tend to be underpriced (Engelen & van Essen, 2010).

The QR results establish that there is a varying relationship between the country- and firm-level independent variables and levels of mispricing. This is apparent when one compares the signs, sizes and significance of the coefficients reported in Table 8.6. In Table 8.7 we report the F-statistics of the equality of slope parameters across the six levels of mispricing. The test results show that the differences between the slope estimates associated with each level of mispricing are significant and justify the use of QR.

Table 8.7: Tests of the equality of slope estimates across quantiles

Level of mispricing	Quantiles	Estimate	p-value
Highly overpriced vs extremely underpriced	0.068 vs 0.888	27.294	0.000***
Overpriced vs highly underpriced	0.2045 vs 0.6635	11.824	0.000***
Fairly priced vs underpriced	0.30 vs 0.439	3.364	0.004***
All levels of mispricing	0.068 vs 0.2045 vs 0.30 vs 0.439 vs 0.6635 vs 0.888	13.583	0.000***

1. The table shows the F-statistics of the equality of slope estimates across the selected quantiles representing the levels of mispricing.
2. Coefficients significant at the level of 1%, 5% and 10% are marked by ***, ** and * respectively.

8.7 Conclusion

This chapter examines mispricing across the combined sample of the four countries. Our results show that the firm-level variables that explain the mispricing of IPOs in single country studies continue to significantly explain mispricing across countries. This confirms that the impacts that firm-level variables (including age, earnings per share forecast, offer size, offer price, underwriter reputation, VC involvement, market performance and volatility) have on mispricing are robust. However, the primary focus of this chapter is the impacts of countries' institutional quality and economic characteristics on IPO mispricing.

Our results show that country-level institutional quality adds to the explanations of variations in mispricing across countries. Consistent with Engelen and van Essen (2010), the countries that have better institutional quality are, overall, less mispriced whereas countries with poor institutional quality are more mispriced. This suggests that if a country has poor institutional quality, this has economic implications for IPOs. In the event of mispricing, money is left on the table and investors are willing to pay higher prices for shares when they buy them in the aftermarket. When the magnitude of mispricing is large, issuers receive lower proceeds, and this raises the cost of raising capital for issuers. This means that because of mispricing, fewer firms will choose to raise capital via IPOs, as the firms that make this choice face higher costs of capital. Hence, in regard to raising capital, firms operating in countries with poor institutional quality are at a disadvantage compared to their competitors in countries with better institutional quality because in those countries it is easier to raise money through IPOs. However, the QR estimates show that this relationship is more pronounced in the mid-region of the distribution, and this relationship does not adequately explain extreme cases of mispricing. This implies

that country-level institutional quality explains mispricing for a relatively more correctly priced IPO, whereas extreme cases of mispricing are explained by firm-level characteristics.

In addition to this, our study is one of the first to examine the impacts of economic size and growth on IPO mispricing. The results are consistent with expectation and with Engelen and van Essen (2010). We find that largest mispricing occurs in developing countries experiencing high economic growth and that larger economic size (i.e. more development) reduces mispricing. This relationship is more pronounced for higher levels of mispricing and it is absent for highly overpriced IPOs. On the other hand, firms in larger economies are less mispriced. Boulton et al. (2010) suggest that rapidly growing economies offer more venues for firms to grow, and so firms in such economies frequently approach equity markets to raise capital, resulting in higher mispricing. The cost of capital is already higher in smaller economies, and mispricing adds to the existing costs for the firm. Therefore, firms going public in slowly growing economies leave less money on the table in the form of mispricing.

Chapter 9: Conclusion

The phenomenon of IPO mispricing has been examined for four decades and has attracted increasing attention in recent years, as measured by the rise in the number of publications. It has been established that IPOs are mispriced to varying degrees around the world, with IPO mispricing being driven by many factors both endogenous and exogenous to the issuing firm. These factors include characteristics of the firm going public, offer characteristics, the characteristics of the market where the firm is going public, risk disclosure, issue certification, market performance, and volatility, as well as country-level characteristics such as the institutional quality and economic strength of the country. A combination of these factors impacts IPO mispricing in different ways, both across firms and across markets.

The objective of this thesis is to contribute to the IPO literature by providing further insights into the mispricing anomaly. Hence, we examine the mispricing of IPOs in four sample markets (the US, Australia, China and Malaysia) that are in different stages of market development. The US is the most developed of the four markets and the one in which the most IPO research has been conducted. The four markets exhibit varying levels of mispricing along with variations in the firm characteristics, offer characteristics and institutional frameworks. These attributes are discussed in detail in the chapters that examine the IPO mispricing in the four markets (Chapters 4–7). These markets also differ in their levels of institutional quality and economic strength. These differences are discussed in Chapter 8. The sample of the four markets consists of 6171 firms that went public in the four countries from 1995 to 2013.

The findings of this thesis support earlier findings that IPOs are on average underpriced and that the extent of the underpricing varies across markets. By addressing the research questions posed in Chapter 1, this thesis provides new evidence on IPO mispricing which shows that: (a) while IPOs are on average underpriced, there is a wide range of mispricing within each of the markets, from highly overpriced to extremely underpriced IPOs; (b) purely concentrating on the underpricing results in an incomplete analysis of IPO mispricing. For example in Malaysia a large proportion of IPOs are overpriced and in China a large proportion

of IPOs are underpriced; (c) the use of the QR method in addition to the OLS method extends our understanding of the variations in the impact of factors across the full range of mispricing; (d) the factors that lead to overpricing are different to the factors that lead to underpricing; (e) mispricing is driven, not only by firm-level factors, but also by the institutional quality and economic strength of a country. A summary of these findings is provided in the coming sections.

9.1 Levels of mispricing

Research question 1: What is the distribution of mispricing across the four markets?

Overall, our results are consistent with previous studies which conclude that IPOs are on average underpriced. However, we find that the means of mispricing distributions are significantly different to the medians. In the US, the mean mispricing is 34.90% and the median is 2.40%. In Australia, the mean mispricing is 25.51% and the median is 10%. In China, the mean mispricing is 112.10% and median is 71.4%. In Malaysia, the mean mispricing is 1.80% and the median is -17.53%. Further, the mispricing distribution is skewed to the right.

A closer inspection of the results shows that IPOs are not all underpriced, and that a relatively high proportion of the IPOs are overpriced. In the US, 35.50% IPOs of IPOs are overpriced. In Australia 37.70% of IPOs are overpriced. In China 6.30% of IPOs are overpriced. Whereas, in Malaysia 59.43% of the IPOs are overpriced. Further, we show that there is a wide dispersion in mispricing within each of the four markets, ranging from highly overpriced to extremely underpriced.

Our finding suggests that the mean is not a good measure of the extent of mispricing in the case of highly skewed distributions. Therefore, in Austtralia, for any given IPO an investor has a 50% of chance to make 10% (median) returns, a 37.70% of chance of losing money and a 16.60% of chance of making above average returns.

Research question 2: What are the factors that contribute to mispricing at different levels of mispricing?

Our QR results provide us with the insights into the characteristics of IPOs with different levels of mispricing. We find that the factors that affect mispricing have a varying impact across the range of mispricing. For example, in Australia, older age of the firm, smaller offer size and offer price significantly impact overpricing. On the other hand, highly underpriced and extremely underpriced IPOs are significantly impacted by not providing earnings forecasts, involving an underwriter and reporting more risk factors. Most of the firms that timed their IPO trading to periods of market euphoria were mispriced to a greater extent.

The factors that impact overpriced IPOs in China are: age (+), earnings per share forecast (+), retained ownership (-), offer size (-), offer price (+), risk factors reported in the prospectus (+), recent market performance and volatility (+), delay in listing (-) and listing on SSE. The factors that impact extremely underpriced IPOs in China are: offer size (-), offer price (+), recent market performance and volatility (-), delay in listing (+) and listing on SSE (-).

The variations in the impacts that the independent variables have across the levels of mispricing is not limited to a single market. We found a different relationship between mispricing and the variables that explain mispricing in developed markets (such as Australia) and under-developed markets (such as China). For example, the factors that were found to cause mispricing in Australian IPOs are; younger age, smaller offer size, lower offer price, absence of an underwriter and high market performance. However, the factors impacting mispricing of the Chinese IPOs included: older age, high earnings forecast, smaller offer size, higher price, high market performance and volatility, long time lapse between the issue and the listing date and listing on SSE. Malaysia had the least amount of mispricing in our sample and we found a different set of factors associated with that mispricing. These factors included; smaller firm size, lower earnings forecast, higher offer price, higher reputable underwriters, higher market performance and low market volatility. A significant relationship that we observe in the Australian and Chinese markets is the impact of offer price on mispricing. In Australia, a lower issue price reduces mispricing, whereas in China firms that have lower offer prices are more mispriced. This is consistent with the proposition put forward by Brennan and Hughes (1991), that issuers in developed markets are using a low issue price as a signal of quality to attract the attention of analysts. On the other hand, in a developing market, a

lower offer price is deemed as risk, as suggested by Beatty and Welch (1996), and hence firms with lower offer prices experience higher mispricing. Similarly, a firm's age is expected to be inversely correlated to ex-ante uncertainty and the resulting mispricing. We find this to be the case with Australian IPOs, but firm age has a significantly positive impact on mispricing in China. Lin et al. (1998) argues that in emerging economies, investors find older firms to be risky, which increases ex-ante uncertainty and results in higher mispricing.

Our findings on the variability of the magnitude of IPO mispricing confirm that the regulatory and institutional frameworks of a country impact the level of mispricing. The relationships of mispricing with the regulatory and institutional frameworks of a country are discussed in the following sub-section.

9.2 Mispricing across countries

Research question 3: How do a country's characteristics impact IPO mispricing?

The discussions on the findings in Chapters 4 to 7 show that IPO mispricing varies across countries as well as within the countries. To explain the cross-country differences in mispricing across markets, we use two country-level characteristics as possible differentiating factors across our sample markets. First, we employ a set of six variables proposed by Kaufmann et al. (2015) to capture institutional quality across countries. Second, we use economic strength (i.e. economic growth and economic size) to capture the impacts of economic structure on IPO mispricing.

Our findings are in line with Beatty and Ritter (1986) who suggest that mispricing is caused by uncertainty surrounding the firm going public. We find that the poor institutional quality adds to the uncertainty about the value of the firm and leads to more mispricing. Firms in countries with higher level of institutional quality are less mispriced.

Our cross-country examination of mispricing is one of the first studies to examine the relationship between a country's economic strength and IPO mispricing. We find that countries with high GDP growth experience more mispricing, whereas developed economies (measured as GDP per capita) are less mispriced.

Another key insight that the cross-country study provides relates to the impact of the book building method on IPO mispricing. We do not find any significant relationship between IPO mispricing and the method of pricing IPOs in single country studies. However, when all countries are studied together, we find that the book building method tends to reduce mispricing. This finding has policy implications, suggesting that a market-oriented mechanism of price setting reduces mispricing. A practical demonstration of this finding is observed in the Chinese market where the adoption of the book building method resulted in a significant reduction in mispricing.

9.3 OLS and QR approaches

The OLS method has been a useful tool for examining IPO mispricing and has been extensively used in IPO research. Our study highlights certain shortcomings of the OLS method: (a) it neglects the issue of skewness that is common in the distributions of mispricing, (b) the estimates obtained from the OLS method provide an understanding of the average relationships between the mispricing and the factors that explain the mispricing but do not allow researchers to differentiate between the effects on IPO across the range of mispricings (c) in the case of right-skewed distribution, the mean of a distribution would have a strong effect of the extreme positive observations and using OLS method in such cases would bias the estimates obtained from using the OLS method.

We adopted the QR approach to examine the impact of the independent variables across the levels of mispricing found in the mispricing distribution. The QR approach has certain advantages over the OLS method: (a) in cases of skewed distribution, the QR approach is a more appropriate technique than the OLS, (b) the QR approach is robust for outliers and does not require the condition of normality, (c) the QR estimates provide a comprehensive picture of the relationships between mispricing and the independent variables across the levels of mispricing, including the tail regions that is not possible using the OLS method.

The results obtained from the OLS estimates show that the independent variables that are used to explain the mispricing phenomenon have different impacts at different levels of mispricing. This variation is consistent across all the four markets. The equality of slope tests conducted to validate the use of QR showed

that the impacts of the independent variables vary significantly across all levels of mispricing in all four countries.

9.4 Limitations and future research

Like any other empirical study, our results should be interpreted with caution. The variables used to examine the mispricing may not reflect a fully developed empirical model. It is possible that some variables are not included in our model which also have an impact on mispricing. For example, we do not have data to examine the role that underwriters play by performing price support activities or by providing analysts' recommendations. We also do not have data that identifies institutional investors and retail investors. It would be insightful to understand the impact that different types of investors have on the levels of mispricing. Such an information would allow to examine Rock (1986) winner's curse model in full (refer to Section 2.2.1.1). Future studies could add these and other variables to develop a better informed model.

Future research could expand our analysis in multiple dimensions. One example being an in-depth analysis of the overpriced IPOs could be conducted to further our understanding of what to date has been a neglected feature of IPO markets around the world. Further, the application of the QR approach to Finance in general, and IPOs in particular is very recent. Studies like ours, Lee et al. (2010), and Badru and Ahmad-Zaluki (2018) provide new perspective about the mispricing phenomenon. Future studies can refine the application of QR approach to provide fresh insights. We have briefly used the scientometric technique to map the mispricing literature and it could be further used to map the literature to identify gaps. Such techniques in combination with data mining techniques would be useful to understand the impact of the language used in IPO prospectus on mispricing. A recent study by Loughran and McDonald (2013) is one such study in this direction. Finally, future studies can extend the finance and growth literature by examining the impact of stock market behaviour in general and IPOs performance in particular on economic development and vice versa, as indeed the money invested in IPOs is a scare economic resource and should be allocated efficiently.

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Appendix A: Process of conducting scientometric analysis

We start with gathering relevant scholarly work which primarily includes journal articles and books. The sources of this information are the databases which are designed to categorise, store, index and distribute the scholarly work. The most commonly used sources for locating relevant peer-reviewed articles are Web of Science, Scopus, and JSTOR. These sources have established electronic databases to store, categorise, index and disseminate the research articles. These databases allow users to access and download the metadata of the stored research articles. The metadata includes attributes of the articles like title, author(s), year of publication, key terms, subject area, journal and in some cases, the abstract. This metadata can be used to establish the scope and breadth of the available literature, identify key authors and conduct some preliminary trend analysis.

Extracting the metadata from these journal databases starts with writing a proper search query. The search query is a combination of keywords which encompass the area of interest – IPO mispricing in our case. The online journal databases then use different sets of algorithms to extract the articles that are most relevant to the entered keywords as the search query. The online journal databases also allow users to apply various filters to the search query to obtain refined search results and the most relevant scholarly work. These restrictions include; searching for the key words appearing in the title and / or abstract and / or anywhere in the article. The online journal databases also allow using multiple keywords in one search query.

We used a combination of search terms “IPO mispricing”, “IPO underpricing” and “IPO overpricing”, in the three main online journal databases (Web of Science, Scopus and JSTOR). The three search terms were used together with “OR” as a logical operator. This means the results that the databases returned would contain at least one of the three abovementioned keywords. The results obtained for the search query are reported in Table A.1. The highest number of articles was returned by Scopus for all the query types. Scopus holds a database hosting 2349 articles with at least one of the three search terms present in them somewhere in the article. When the keyword search stipulated that the keyword had to be present in the

abstract of the article, Scopus reported 605 articles. Finally, there were 185 articles with Scopus whose title contained either "IPO mispricing", "IPO underpricing" or "IPO overpricing". Web of Science hosted 406 articles with the keyword anywhere in the article with 123 articles having the keyword appearing in their title.[32] Lastly, JSTOR hosted 663 articles with the keyword "IPO mispricing", "IPO underpricing" or "IPO overpricing" appearing somewhere in the article, with 373 and 177 articles having the keyword appearing in their abstract and title respectively.

Table A.1: Distribution of articles by query and database

Query type	**No. of articles**		
	Web of Science	**Scopus**	**JSTOR**
Anywhere in the article	406	2349	663
Abstract	NA	605	373
Title	123	185	177

1. This table breaks down the number of articles sourced from each database.

For creating the word-clouds shown in Figure 1.2 and Figure 1.3 we used the data obtained regarding keywords that appear in research papers to classify the concept of the paper, and the corpus of abstracts of 2349 articles that were sourced from Scopus. The 2349 articles were those which had one of the keywords (IPO mispricing, IPO underpricing or IPO overpricing) appearing anywhere in the article. The body of text that is obtained from putting all the keywords and abstracts together is cleaned by filtering out the stop words.[33] The size of the word is directly proportional to the frequency it is used – that is, a bigger font means the word was frequently used.

The additional features that these online journal databases offer is that they store metadata of the article including year of publication, author(s) name, subject area and the source where the article is published. The year of publication can be used to rank the articles from the oldest to the newest. Publications can also be ranked according to the frequency of publications per year which indicates the evolution of the topic over the years. The year of publication information was used to create Figure 1.1.

[32] Web of Science does not show abstracts of the articles in search results.
[33] Stop words are the most common words that appear in text, such as a, an, the, this, is, are, it etc. The stop words are removed from the body of text before it is processed.

Appendix B: Definitions of variables and sources

Table B.1: Snap shot of all the variables used in the thesis

Variable	Symbol used	Definitions	Source
Firm assets	$logAssets_i$	Logarithm of one plus pre-IPO total assets. *Used in: all four countries' studies and the four countries combined study*	IPO prospectus, SDC platinum
Firm age	$logAge_i$	Logarithm of the firm's age in years calculated from the difference between the foundation year and the time of the IPO. *Used in: all four countries' studies and the four countries combined study*	IPO prospectus, company website, Jay Ritter's IPO database
Earnings per share forecast	EPS_i	EPS is the forecast earnings per share given in the prospectus. *Used in: the US, China and Malaysia studies*	IPO prospectus
	$EPS\ dummy_i$	A dummy variable with the value of 1 if earnings forecast is provided in the prospectus and 0 otherwise. *Used in: Australia study*	
Retained ownership	$RetOwn_i$	Calculated as one minus the number of shares issued / total number of shares outstanding. *Used in: all four country studies and the four countries combined study*	IPO prospectus, SDC Platinum
Offer size	$logOS_i$	Logarithm of offer size measured from the final offer price multiplied by the number of shares offered. *Used in: all four countries' studies and the four countries combined study*	IPO prospectus, SDC Platinum
Issue method	IM_i	A dummy variable with the value of 1 if the IPO is a fixed price offer and 0 for book building offered. *Used in: all four country studies and the four countries combined study*	IPO prospectus, SDC Platinum
Inverse of offer price	$InvOP_i$	One divided by final offer price per share. *Used in: all four country studies and the four countries combined study*	IPO prospectus, SDC Platinum
Underwriter market share	UMS_i	Calculated as the sum of total capital raised in IPOs by the underwriter in a year '*t*', divided by the total capital raised by all the IPOs in the year '*t*'. *Used in: the US, China and Malaysia studies*.	IPO prospectus, SDC Platinum, Bursa Malaysia
	UW_i	A dummy variable with a value of 1 if a financial institution is involved in the role of an underwriter and 0 otherwise. *Used in: Australia study*	

Table B.1 (continued)

Variable	Symbol used	Definitions	Source
Venture capitalist	VC_i	A dummy variable with a value of 1 if the issue had venture capitalists as shareholders at the time of the issue and 0 otherwise. *Used in: all four country studies and the four countries combined study*	IPO prospectus, SDC Platinum
No. of risk factors	RF_i	No. of Risk Factors measures the risks reported in the IPO prospectus. *Used in: China, Malaysia and the US studies and the four countries combined study*	IPO prospectus
	$logRF_i$	Logarithm of the number of risk factors reported in the IPO prospectus. *Used in: Australia study*	
MarketPerformance$_{t-30}$	$MP30_i$	Pre-IPO 30-day performance of the market index where the stock is listed. *Used in: all four countries' studies and the four countries combined study*	Datastream
Realised volatility $_{t-30}$	$RelVol_i$	pre-IPO 30-day relaised volatility of the market index where the stock is listed calculated as the square root of $(252*\sum(\ln(PX_{t-i}/PX_{t-i-1}))^2 / N)$. *Used in: all four countries' studies and the four countries combined study*	Datastream
Listing exchange	$Exchange_i$	A dummy variable with value of 0 for the IPOs listed in the NYSE and 1 for those listed in the NASDAQ. *Used in: the US study* A dummy variable with value of 0 for SSE and 1 for SZSE. *Used in: China study*	IPO prospectus, SDC Platinum, Stock exchange websites
Board	$Board_i$	A dummy variable with value of 1 for IPOs listed in the Main Market and 0 for ACE Market. *Used in: Malaysia study*	IPO prospectus, Bursa Malaysia website
Lag days	$logLagDays_i$	Logarithm of one plus no. of days between IPO date and listing date. *Used in: China study*	IPO prospectus, Morningstar
Control of corruption	$ContofCorr_i$	Capturing perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. *Used in: combined study of all four countries*	Kaufmann et al. (2015)

Table B.1 (continued)

Variable	Symbol used	Definitions	Source
Government effectiveness	$GovtEff_i$	Capturing perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. *Used in: combined study of all four countries*	Kaufmann et al. (2015)
Political stability	$PoliStab_i$	Capturing perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism. *Used in: combined study of all four countries*	Kaufmann et al. (2015)
Regulation quality	$RegQual_i$	Capturing perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. *Used in: combined study of all four countries*	Kaufmann et al. (2015)
Voice and accountability	$VoiceAndAcct_i$	Capturing perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media. *Used in: combined study of all four countries*	Kaufmann et al. (2015)
Rule of law	$RuleOfLaw_i$	Capturing perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. *Used in: combined study of all four countries*	Kaufmann et al. (2015)
GDP per capita	*logGDP/Capita*	Logarithm of gross domestic product per capita. *Used in: combined study of all four countries*	World bank's data catalogue
GDP growth rate	*GDP growth* (%)	Annual percentage change in gross domestic product per capita. *Used in: combined study of all four countries*	World bank's data catalogue

1. The table provides a snapshot of the variables used in the thesis, their symbol, description and the data source.