ON THE DETERMINANTS OF INITIAL PUBLIC OFFERING UNDERPRICING

Yongyuan Qiao

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On the Determinants of Initial Public Offering Underpricing

Yongyuan Qiao

A thesis presented for the degree of

Doctor of Philosophy in Economics

University of St Andrews

16 Oct 2008

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Abstract

The initial public offering (IPO) underpricing phenomenon has frequently been noticed and generally is accepted as a puzzle in financial economics. Some of the new theories, such as behavioural finance, take the underpricing puzzle as one important form of evidence. However, some aspects of IPO underpricing have not yet been fully documented and discussed in the existing literature. This thesis tries to contribute in the following three specific areas.

First, we focus on the time series properties of the level of underpricing of IPO shares and document the IPO market in the Hong Kong market from 1999 to 2005. In the data sample, strong autocorrelation within the level of underpricing has been discovered. Evidence suggests the initial selling volume plays an important role in the relationship. The links between underpricing and clustering of IPOs within different industries are weak, suggesting the reasons for underpricing are related to the market liquidity rather than to the industry-specific risk characteristics.

Second, we investigate the underwriting networks to explore the relationship between underwriting business and IPO related puzzles. We find that in repeated IPOs, underwriters build up reputation and accumulate knowledge of their underwriting services. One of the great advantages of the top ranked underwriters is their relationship

networks with other underwriters and institutional investors. We perform a careful examination of the underwriter syndicate and investigate the relationship of the structure of the syndicate in respect of IPO performance. Moreover, the pattern of distribution in the size of syndicates is identified and is found to be significantly related to the IPO performance. The research shows that the perspective from the underwriter syndicate is not only interesting, also necessary to understand IPOs.

Third, we analyse the coordination problem in the IPO. In the research, we consider the auction method as a one-stage selling and the bookbuilding method as a two-stage selling method. The model suggests that the relationship between the underpricing level and the quality of IPO shares is non-monotone. This implication is consistent with empirical observations. In addition, regarding the issuers' proceeds in the IPOs, the auction method is better than the bookbuilding method in both noisy and noisy vanishing equilibria. The bookbuilding method may be helpful in other ways, such as maintaining liquidity or price support in secondary market.

By studying liquidity, business networks and the coordination problem, the thesis does not only complement the existing research by providing unique explanations for the IPO underpricing and other related puzzles, but also opens some interesting venues for future research.

JEL Classifications: G14; G11; G24; G32.

Keywords: IPO; underpricing; clustering; liquidity shock; underwriter syndicate; random graph; coordination problem; global game.

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Introduction

Underpricing of initial public offerings (IPO) can seem too remote to worry about, even for firms that are planning to go public; or too uncertain, in the sense that the level of underpricing varies over time and is unpredictable. On the long journey from making the decision to going public and filing the IPO forms, the firm might think that the underpricing level is not important as the underpricing level is at less than 10 per cent and the firm gets more than 90 per cent of the investment. You have to pay for underwriting fees and other fees anyway.

These comforting thoughts, however, cannot prevent the severe facts. Although the level of underpricing is on average small, we have a huge cake of IPOs. For example, Baidu.com, a search engine company based in Beijing, listed in NASDAQ in 2005, raised $109 million in its IPO. If we look at other countries, during the year of 2005, IPOs raised $33,086 million in United States, $24, 263 million in China, $6,231 million in Japan and $2,903 million in South Korea. Looking at regions and areas, the total funds raised in IPOs in 2005 is $61 billion in Asia, $41 billion in Europe and $39 billion in North America. Globally, we can find that 24 IPOs raised more than $1 billion. [1] Given the cake is huge, even a very small bit of underpricing would leave a great amount of money on the table. Taking the 10 per cent underpricing as average, it is estimated that at least $2.4 billion were left on the table by the underpricing of IPO shares in the year 2005.

[1] Ernst & Young, 2006, Accelerating Growth: Global IPO Trends 2006, www.ey.com/ipo

Moreover, sometimes we see huge underpricing. Let us take Netscape's IPO in August 1995 for an example. In this IPO, 5 million shares of Netscape were sold to investors at the price of $28.00 per share. At the end of the first trading day, however, the closing price was $58.25. On that day, $151 million were left on the table and collected by the lucky subscribers in the primary market. Netscape's IPO is not unique. According to Loughran and Ritter (2003), during the internet bubble period of 1999-2000, the average underpricing level was 65%. Before this crazy period, the underpricing level was at 7 per cent in 1980s and 15 percent during 1990-1998.

In respect of the *de facto* significant amount of money on the table, it is now hard to tell if all the investments are efficient. Think back to 1999 when the internet bubble began. All the investors at that time were not chasing profitable projects, but IPO shares. No matter what was there in the IPO shares, a "dot com" label was enough to make the "buy" order. On the contrary, relatively less money could be invested into other profitable industries. It thus seems that in the IPOs, underpricing of shares suggests that underwriters do not fully incorporate all available information into the offer price. As we all know, the mispricing of assets leads to inefficient investments. An inefficient investment means you pay too much more than it is worth, or too little.

It is easy to understand the inefficiency, but difficult to accept the existence of mispricing in the world of arbitrage. Academic financial economics theory has been

long established on the efficient market hypothesis. In the efficient market hypothesis, the risks are incorporated into asset prices. Arbitrageurs can buy the underpriced shares and then sell them, when the price is right. Rational expectations were a perfect tie between finance and the entire economy in the theories of the 1970s. At that time, Merton (1973), Lucas (1978) and Breeden (1979) published their famous work on the framework of rational expectations in succession. The efficient market theory thus dominates finance theory. Almost at the same time, however, we can see the beginning of reporting anomalies, such as stock market returns' serial dependencies and close end fund puzzles. Among those puzzles, IPO underpricing is one of great importance. Consequently, research into the IPO underpricing puzzle also has theoretical implications. (Shiller, 2003)

The Scope of the Thesis

We would like to focus on the IPO underpricing related issues, from the critical questions the efficient market theory needs to face. Specifically, we investigate into the following three factors: liquidity, information and risk.

One of the most important assumptions of the efficient market is that we live in the world of arbitrage, where the arbitrageurs can profit from the mispriced assets. The premise of the arbitrage world is that arbitrageurs can borrow as much as they wish, while behavioural finance theory argues that in the real world arbitrage is limited. The

liquidity is thus an important factor to be explored in these puzzles. In this thesis, we collect information about a series of IPOs to investigate whether there is series dependence from the perspective of liquidity.

Information flows are difficult to detect by empirical studies; however, investigations into information channels are possible. Underwriters' connections with investors, especially institutional investors, and other underwriters are believed to be of importance. The underwriters' network is the channel for the information about IPO shares to be gathered and then distributed. It is easy to figure out the channel, but difficult to characterise and measure it. Among existing network analysis techniques, we try to implement a proper one. We expect to see the influence on the IPO performance from different underwriters.

Risks associated with IPO shares are generally believed to arise from investors' sentimental and poor historical information about the shares. Although literature on IPO risks are extensive, few noticed that failure of the IPO is one of the possible outcomes. Here we try to investigate the coordination risk during the offering processes. Given that a certain amount of shares needs to be sold out at once, it is interesting to know about the possibility of the failure. Meanwhile, we should also notice that underwriters, who suffer from the failures, must try their best to prevent an IPO from failing due to the coordination problem. As a result, it is also possible to understand

the puzzling mechanism of IPO, including bookbuilding and the separation of primary and secondary markets, from the perspective of the coordination risk.

Outline of the Thesis

We review the literature on IPO related issues in the first chapter. In the review, we focus on the advantages of choosing IPO as a way of raising funds, and then discuss other possible choices besides going public, such as private offering. Furthermore, we compare the internal capital market with the external capital market. Then the review continues by focusing on the IPO related puzzles, mainly on the underpricing puzzle, and surveys the offering mechanism globally. At the end of Chapter 1, we review the theoretical literature on IPO underpricing.

In Chapter 2, we start to study the liquidity factor of IPO shares from the empirical evidence in the Hong Kong market from 1999 to 2005. From the time series dependence of the underpricing level, we find that it is reasonable to believe that liquidity is significantly influential in the level of underpricing. Together with IPOs' clustering, evidence suggests that the issuers tend to choose the specific time to go public. Empirical evidence suggests that an increase in the initial selling volume leads to more severe underpricing. We believe that in some sense, underpricing is a kind of compensation for the liquidity shock in the market caused by a huge amount of selling shares.

Chapter 3 examines the information flow during the offering from the perspective of the underwriter network. First we develop unique measurements to characterise the underwriter syndicate and then examine the influence of different characteristics on the IPO performance. Second, the distribution of syndicate size illustrates that there are two groups of underwriter syndicates, and that the performance of the two groups differs significantly. The research shows that the perspective from the underwriter syndicate is not only interesting, but also necessary. Underwriters, as information channels, are indeed important to the underpricing puzzle.

In Chapter 4 we consider the coordination risk in the IPO offering by implementing global game theory. We provide the explanation of underpricing from the perspective of the coordination problem as well as the non-monotone relationship between underpricing level and the quality of IPO shares. The implication of the model is consistent with empirical observations. We also examine the issuers' proceed in the auction method and the bookbuilding method in the model. The finding suggests that the issuers' proceeds are higher in the auction than in the bookbuilding method. Nevertheless, we only consider two selling methods from the perspective of global games in the model. The bookbuilding method can be helpful for issuers in other ways.

Chapter 5 discusses the implications of the research and then concludes with the outlook for further research in IPO related puzzles.

Chapter 1
Literature Review

Just as with famous puzzles in other fields, IPO underpricing is attractive for scholars. The level of underpricing is, on the one hand, money left on the table. Investors' investment in the primary market increases dramatically on the first day of trading in the secondary market. The following information about the top 10 biggest underpricing cases during 1975-2004 in the U.S. market explains the reason why this puzzle is so popular: Va Linux, 697.50%, 1999; Globe.com, 606%, 1998; Foundry Networks, 525%, 1999; Webmethods, 507.50%, 2000; Free Markets, 483.33%, 1999; Cobalt Networks, 482%, 1999; MarketWatch.com, 474%, 1999; Akamai Technologies, 458%, 1999; Cacheflow, 426.56%, 1999; Sycamore Networks, 386%, 1999.[2] On the other hand, the IPO underpricing puzzle challenges the classic theory in financial economics, the efficient market hypothesis (EMH). Scholars could have the chance to show the power of their theories if they could successfully explain this puzzle. Among the relevant theories, behavioural finance is a relatively successful one. As the proposed explanations for the puzzle are numerous, we list some of them in Table 1.1.[3]

In this chapter, we review the literature on IPO-related issues as well as the practice of IPO in the financial market. In addition, we focus on the advantages

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[2] Ritter, Jay, 2008, "Big IPO Runups of 1978-2006", University of Florada, Working paper.

[3] Summarized by Brau and Fawcett (2006).

No.	Explanations	Research paper
1	To protect against possible future litigations by investors	Tinic, 1988 Hughes and Thakor, 1992 Drake and Vetsuypens, 1993
2	To compensate investors for taking the risk of the IPO	Beatty and Ritter, 1986 Rock, 1986
3	To ensure a wide base of owners	Booth and Chua, 1996 Brennan and Franks, 1997
4	To allow for the creation of a blockholder for increased monitoring	Stoughton and Zenchner, 1998
5	To reward investors for divulging accurate valuation information	Benveniste and Spindt, 1989 Benveniste and Wilhelm, 1990 Spatt and Srivastava, 1991
6	Issuers are pleasantly surprised with the amount they can raise in the IPO	Loughran and Ritter, 2002
7	To start a domino or cascade effect among investors	Welch, 1992
8	To allow for cost saving in other areas of marketing the issue	Habib and Ljungqvist, 2001
9	To increase the post-issue trading volume of the stock	Boehmer and Fishe, 2001
10	To bring attention to the stock on the opening day	Demers and Lewellen, 2003
11	To allow for spinning	Maynard, 2002 Griffith, 2004
12	To allow for flipping by favored investors	Aggarwal, 2003 Fishe, 2002 Krigman et al., 1999

Table 1.1: List of theories and explanations for IPO underpricing

of choosing IPO as a way of raising funds, and then discuss other possible choices besides going public, such as private offering. Furthermore, we compare the internal capital market with the external capital market. The review then focuses on the IPO-related puzzles, mainly on the underpricing puzzle, and surveys the offering mechanism globally.

1.1 Going Public

1.1.1 An important step for a firm

Being a public company means much more than opening a new channel of raising funds and diversifying the structure of your shareholders. Not only are you going to see many strangers on the board of the firm, but your company will be put under the light spot for all potential investors' careful examination. Everything you are going to face starts with the important step: Initial Public Offering (IPO).

The advantages of IPO are plenty. Going public enables a company to raise fund from public equity and opens an avenue for trading the company shares. Publicly traded shares make it easier for the existing shareholders of the company to liquidate their holdings for cash, or diversify their portfolio, which is essentially the goal of some venture capitalists. The publicity of being a public held company will also build up a good reputation for the company. Meanwhile, the ability to raise large funds from the capital market is also one of the key reasons why companies are ea-

ger to go public. One of the many by-products is that by having diversified investors, a company is able to build up its business network and tighten its connection with the suppliers and clients.

1.1.2 Alternative choices

It is well known that going public is costly and that it is not an easy call to make. One alternative way of financing a project would be using private financing, such as venture capital. Chemmanurz and Fulghieri (1999) examine this question for the first time, while previous discussions about being a publicly held firm rarely mention the difference between raising fund from the public and through private placement to institutional investors, such as venture capitalists. These authors start their research by focusing on three basic differences between private and public firms.

First, public firms are generally associated with more dispersed share ownership. The dispersed ownership may lead to two consequences. One is that the equity holders are diversified, in respect of their investment judgement and expertise. The other consequence is that the diversified shareholders will have much less bargaining power against the firm's management than a limited number of block shareholders in private firms.

Second, it is even more costly to convince a much larger group of investors that its projects are worth investing in than to sell shares to the public. The cost of selling

results in a greater cost of financing, which ultimately lowers the profitability of the project and forms a burden for investors.

Third, the public market trading of shares produces a publicly observable share price. The difference is straightforward. The public market in the paper is the place where firms are able to sell equity to numerous investors, each with a relatively small proportion of shares, while the private placement of equity is block selling. It is thus believed that in the above settings, a private placement to large investors has the advantage of minimising the information production cost, while the disadvantage of private placement is that the block shareholder will have greater bargaining power and will require a greater rate of return on the equity. Some interesting implications can be drawn from their model. On the one hand, the public firms are not only older on average than the private firms, but also larger in market value. On the other hand, the ages when firms go public differ in different industries. Firms in a more capital-intensive industry go public earlier. Given the capital-intensive degree at the same level, the firms, which is more difficult to evaluate, will go public later. In addition, the model implies that firms in different countries (with different financial market and financial institutional regulations) go public at different ages.

For example, the average age when firms in European countries go public is older than in the U.S. This prediction is verified by the facts documented by Pagano, Panetta, and Zingales (1998). They found that the average age for Italian companies going public during the period 1982 to 1991 was 33.4 years, while in the U.S., the

average age was 6.7 years for venture capital backed firms and 11 years for non-venture capital backed firms (Gompers, 1993; Lerner, 1994).

Another alternative way is to finance projects by cash flow from the firm itself, which is the first thought when a firm needs to finance a project. This notion is extensively discussed in the series of papers entitled "The Dark Side of Internal Capital Market" by Scharfstein and Stein in 1998 and 2000. It is believed that theoretically, there are two capital markets, one internal and the other one external. Once facing difficulties in financing, besides seeking help from the external capital market, a firm normally can choose to join or be acquired by a holding group or a conglomerate group.

Lamont (1997) and Shin and Stulz (1998) document the evidence that reveals that conglomerates' headquarters do engage in active resource reallocation and move funds from one division to another. Obvious evidence is that of the new holding groups in emerging markets, especially East Asia, such as Japan and South Korea.

Let us take Japan here as an example. According to Hoshi, Kashyap and Scharfstein (1991), there has been six large industrial groups in Japan since the 1950s: Mitsubishi, Mistui, Sumitomo, Fuyo, Dai-ichi Kangyo, and Sanwa. An important feature of these groups is that they are both diversified and vertically integrated. The Mitsubishi group, for example, has member firms in the automobile, beer and chemical industries. Among the top 200 Japanese firms, 89 firms have strong business connections with one of the six largest groups. These 89 Japanese

firms take 40% to 55% of total sales in the natural resources, primary metal, industrial machinery, chemical and cement industries. Moreover, affiliated firms do much of their business within their group. As estimated by Gerlach (1987), the affiliated firms are three times more likely to do business with other firms in their group than with unaffiliated firms.

However, there are also some disadvantages in the internal market. It is normal to see the internal capital market playing a very important role in conglomerate groups. In such groups, it is generally believed that the management agencies are more likely to make inefficient investment decisions. One reason for this is that managers can do a worse job in investment within conglomerate groups. Given that some believe managers are likely to over-invest using the free cash flow, the conglomerate groups offer the managers a larger free cash flow to play with. Another reason might be inefficient cross subsidies. As the conglomerate groups have a large free cash flow, the cross divisional subsidies may be favourable to some divisions while other divisions are neglected.

Specifically, Scharfstein and Stein emphasise the rent seeking in the holding group hierarchies, claiming that the managers in charge might derive personal benefits from rent seeking in such internal investment and reallocate funds to the "weak" projects. In the paper, Scharfstein and Stein build a model with two layers of agencies, focusing on the question of how divisional managers apply fund allocations from their CEOs. Their model not only provides a theoretical framework for analysis

of the existence of the inefficient internal capital market, but also makes predictions regarding the direction of such cross subsidies and the circumstance in which the cross subsidies are likely to occur. They predict that in the conglomerates where the divisions' strengths are diverged, the inefficient cross subsidies are more likely to happen.

Rent seeking will ultimately lead to the inefficient allocation of investment spending. Ultimately, the inefficiency of investment spending and rent seeking contribute to the cost of financing. As a result, as recorded by Bhagat, Shleifer, and Vishny (1990), and Berger and Ofek (1996), the diversified firms with a greater internal capital market apparently have a lower trading price in the financial market than their specialised peers.

The advantages of the internal market are also widely discussed. Williamson (1975) argues that internal capital markets provide headquarters with valuable flexibility to reallocate funds from less desirable projects to more desirable ones. In addition, if the group has projects in related businesses, the informational asymmetry between headquarters and projects is greatly reduced and thus the headquarters can allocate the resources better. This also reduces the incentive for poorly performing projects to expand.

Stein (1997) believes the rationale for the existence of the internal capital markets lies in a credit-constrained setting. In such a setting, not all positive net-present-value (NPV) projects can be financed. Consequently, the headquarters can create

value by actively reallocating funds across different divisions to give more help as needed. The second assumption of the model is that the headquarters have the incentive and the authority to reallocate resources between different divisions. Based on the model, Stein argues that where the external markets are relatively underdeveloped in respect of information and agency problems, the internal capital markets tend to be the most effective arrangement. Further to the distinction between headquarters and bank lenders, following Diamond's (1984) model, Stein notes that the headquarters' primary task is to reallocate a fixed pool of funds, while the purpose of bank lenders is to bring more funds to some individual projects.

Moreover, Khanna and Tice (2000) argue that since managers are less likely to lose their jobs than in a less diversified firm, they are more likely to make decisions that increase firm value. As a result, the internal capital market in related diversified groups should be more efficient. Khanna and Tice (2001) report their observation of retail industry firms based on Wal-Mart's entry from the perspective of internal market efficiency. They believe since Wal-Mart's entry into a new market can be seen as exogenous, the competitors' performance can be interpreted as the response to the shock. The authors compare the competitors' investment decisions around the time of Wal-Mart's entry and find that: first, focused and diversified firms are similar in size and in debt levels before the shock but diversified firms are significantly more productive than those they are compared with. Second, after the shock, diversified firms make decisions more quickly to either stay and fight, or to exit the business.

If staying, diversified firms invest more and their decisions are more sensitive to productivity.

1.2 Empirical Studies on IPO Puzzles

1.2.1 The underpricing puzzle

As early as the 1970s, Ibbotson (1975) documented the underpricing phenomenon of IPO shares. He tests the hypothesis that new shares seems to be issued at a lower price than the market price in the secondary market and found that the newly offered shares is on average discounted by 11.4%. Later, Ibbotson and Jaffe (1975) found that compared to the market return, IPO shares got 16.8% excess return on average. In concluding these findings, Ibbotson first described the newly offered shares' discount as a "mystery".

In another empirical study, Beatty and Ritter (1986) record that in the period from 1977 to 1982 in the U.S. market, for "hot issues" the oversubscription ratio is as much as 20. The authors note that while many IPO shares shoot up in price on the first trading day, many other issues' prices decline. Thus, given that the average IPO share prices are underpriced in primary markets, investors are not guaranteed to profit on the first day of trading in secondary markets. Considering a model of an equilibrium underpricing level, it is reasonable to believe that the underpricing is the compensation for the "*ex ante* uncertainty". The greater *ex ante* uncertainty

leads investors expecting for a greater underpricing level. In the empirical study, the authors employ two proxies for the ex ante uncertainty. The first one is the number of uses of proceeds published as the result of Securities and Exchange Commission (SEC) regulations. Firms are reluctant to publish very detailed information about the use of their net proceeds for the two following reasons: legal liability and the disclosure of information to competitors. The second proxy used is the inverse of the gross proceeds raised in the IPO. The latter proxy captures the relationship that on average, smaller offerings are more speculative than larger ones.

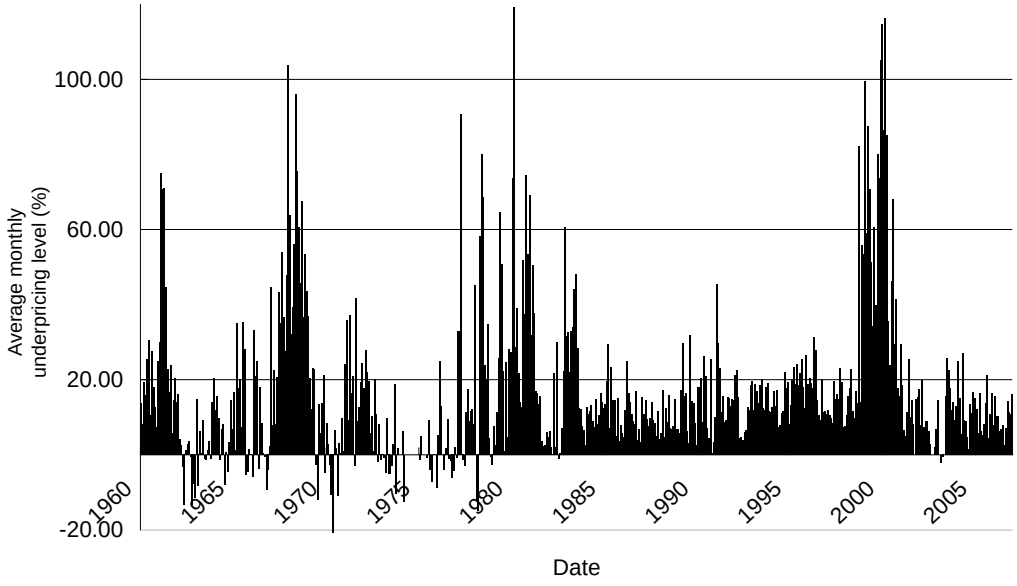

Figure 1.1: Average monthly underpricing level from 1960 to 2006

Throughout the period from 1960 to 2003, the quarterly average underpricing level in the United States market for IPO shares is between 10 and 20 per cent, and

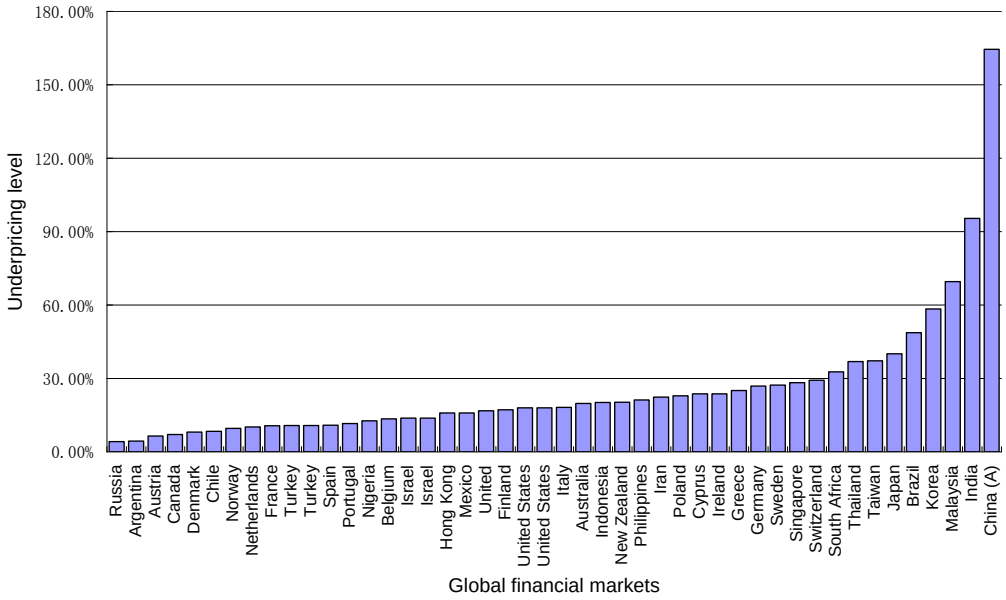

Figure 1.2: Average underpricing level in global financial markets for IPO shares

it varies over time. (Figure 1.1[4]) Moreover, underpricing is observed world wide, among both developed markets and emerging markets. According to Ljungqvist (2004), in the period 1990-2003, the IPOs were underpriced on average by 11 per cent in Austria, and by 9 per cent in Denmark. In Asia-Pacific and Latin American markets, the statistic data illustrate that the underpricing level in Hong Kong for example is 18 percent during the period 1990 to 2001, and 89 per cent in Malaysia. (Figure 1.2[5])

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[4] Source: Jay Ritter, "Monthly number of IPOs and the average first day return", http://bear.cba.ufl.edu/ritter, Jan, 2006.

[5] Source: Jay Ritter, "Average first day returns for 39 countries", http://bear.cba.ufl.edu/ritter, updated in 2008. Please note that the data from different markets may be collected during various periods due to the availability of data.

Besides the underpricing puzzle, financial economists have considered a number of empirical phenomena associated with underpricing puzzle, such as long-term underperformance and aftermarket liquidity. In this review, we highlight the following major puzzles in the existing literature: share allocation in the primary market; IPO cycle and seasonality; long run underperformance.

1.2.2 IPO share allocation and oversubscription

As the offering price is the same to all investors, and the demand generally exceeds the supply in the primary market, it is entirely the underwriters' call as to how to allocate IPO shares to investors. Koh and Walter (1989) perform the first careful examination on the allocation issues. They test the allocation of IPO shares related to the underpricing level during the period of the 1970s and 1980s. Their research is conducted with a sample of data from the Singapore IPO market, a special market in the sense that all investors apply for the same number of shares and all have an equal chance. In addition, the allocation policies are publicly available. Nevertheless, in other markets, such as that of the U.S., the allocation policy of underwriters is strictly restricted as regards the public.

From their investigation, the authors find that the uninformed investors' returns are not significantly different from the risk-free rate of return in the market. Their observation is consistent with the prediction that underpricing as a source of excess return eventually produces an equilibrium offer price, which can attract uninformed

investors to the issue. Moreover, their analysis suggests that the offer price in primary markets is set above the uninformed investors' estimated price.

Saunders and Lim (1990) confirm the allocation problem with updated data from the Singapore market. Lee, Taylor and Walter (1996) suggest that according to the requirement of the Singapore Stock Exchange, smaller investors are systematically favourably allocated for IPO shares. In addition, compared with the demand of small investors, the demand of the large investor is significantly more sensitive to the realised level of underpricing. Lee et al. also document that the oversubscription level is not a function of the underpricing level. In the sample used of 128 IPOs in Singapore, the median level of over subscription is 14.1 times.

Hanley and Wilhelm (1995) present direct evidence on IPO shares allocation, which supports the argument that institutional investors dominate the short-run profit in offerings. Using confidential IPO share allocation data from 38 IPOs underwritten by a single underwriter during the period from 1983 to 1988, the authors find that approximately 70% of the shares are allocated to institutional investors. Across IPOs with different levels of realised underpricing, i.e. "hot" (high underpricing level) or "cold" (low underpricing level or no significant mispricing), the institutional investors' share of the allocation is always at the same level.

On the contrary, the Wall Street syndicate manager, quoted by *Business Week*[6], estimates that the institutional investors take 80% of shares in highly underpriced

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[6] *Business Week*, April 4, 1994, "Beware the IPO Market", Cover Story.

IPOs and 60% of shares in normally underpriced IPOs. In the same article, John Markese (president of American Association of Individual Investors) says, "After the institutional graze the market, there isn't a whole lot left. We've basically suggested that if you can get [some shares in an offering], you probably don't want it."

Lee et al. (1999) confirm that institutional investors profit a lot from their favourable allocations of IPO shares. This research is based on the sample of 132 IPOs underwritten between July 1973 and December 1992. The result shows that the demand by large investors is positively associated with the realised underpricing. They repeat the test applied by Hanley and Wilhelm (1995) and find that the proportion of the allocation to institutional investors and the underpricing level are positively related, though not significantly so.

Ljungqvist and Wilhelm (2002) report evidence found on allocation of IPO shares from the revision activities from offering prices. With the revision information of the IPO offering price, they find that institutional investors are rewarded with favourable allocations of the underpriced shares for providing their private information on the IPO shares to underwriters. Moreover, they find that the proportions of favourable allocations have a nonlinear relationship with both the revisions and the level of underpricing. Given that all other variables are the same, there is weak evidence that the underpricing diminishes when institutional investors receive more than 10% of the average allocation.

It is understandable that research into the allocation of IPO shares is performed in a limited number of markets, because the allocation information of IPO shares is confidential in most global financial markets. After all, empirical studies mainly focus on two points. First, is there any significant relationship between the degree of underpricing and the distribution of shares among different groups of investors, for example institutional investors and individual investors? If such a relationship exists, to what extent, do the underwriters favourably allocate the shares to certain investors and why is this the case? Second, in different IPOs, such as highly underpriced ones, can the favourably-allocated investors gain information about the underpricing level in advance, and adjust their demand accordingly for the shares?

Although a lot of work has already been done, further investigation remains of importance to IPO research. Such investigation will no doubt, however, be very difficult because of the confidentiality of IPO allocation data. The uncovered sample of IPOs up to now is arguably biased given that the samples of IPOs were not randomly selected, because in the existing literature IPOs were usually conducted by one, or a few, underwriters.

1.2.3 IPO cycles and bubbles

In the nature of IPOs, individual firms go to public markets to raise funds. Instinctively, the pattern of frequency of IPOs should be random over time, since firms make

their decisions independently. However, this is not the case and it seems that there is an established IPO cycle over time. The "Dot-com" bubble is an example.

The “Dot-com bubble” is in general characterised by a surprisingly high price level in the period of one year between 1999 and 2000, and it is named after the most significantly overvalued industry: internet service industry. Since the online companies were usually named using “.com”, the “dot-com bubble” is a lively way of describing that exciting period. Notably, the price level was not the only remarkable phenomenon in that period. The average level of underpricing of IPO shares, or so-called “first day return”, also reached and broke its historical record in the same period of the bubble.

As recorded by Ljungqvist and Wilhelm (2002), the underpricing level was on average at 69% in 1999 and 56% in 2000, while the underpricing level in 1996 was 17%. In the bubble period, the IPOs in the internet industry were on average at 88%, which is a even surprising level. Along with this abnormal underpricing level, there are some other unusual characteristics of the bubble period. First, the insiders’ stake before going public shrinks during the bubble period. The insiders’ stake decreased from 63% in 1996 to 51% in 2000, and the CEO stake declined then more significantly by more than one half, falling from 22.8% to 11.5%. Second, the proportion of all internet firms going public increased dramatically compared to all firms in other industries. Before the bubble, the proportion was 3-12%, compared with 55% in 1999 and 36% in 2000. Third, the ages of firms going public fell during

the bubble. The average age of issuers dropped from 14-18 years old in the pre-bubble period from 1996-1998 to 10-11 years old in the bubble. The median age fell by a third, from 8-9 years to 5-6 years. The final remarkable characteristic is the weakening profitability. Measured by the most recent year's net income after tax, the proportion of issuers with non-positive earnings increased from 43% in 1996 to more than 75% during the bubble. Figure 1.3 clearly illustrates the seasonality of IPO market by the number of IPOs.[7]

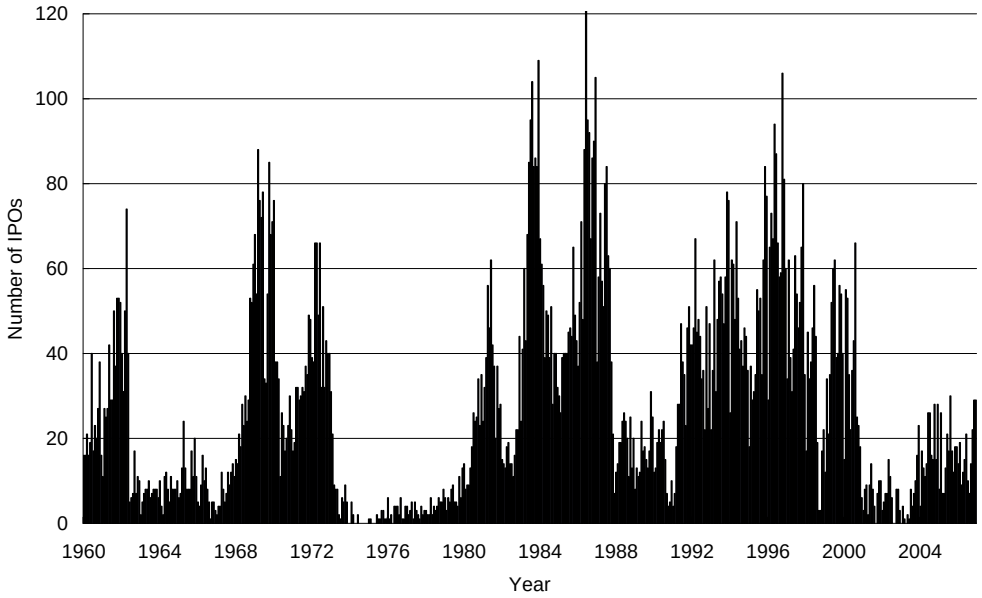

Figure 1.3: Number of IPOs (monthly) in the U.S. market from 1960 to 2006

[7] Source: Jay Ritter, "Monthly number of IPOs and the average first day return", http://bear.cba.ufl.edu/ritter, Jan, 2006.

1.2.4 Long-term underperformance puzzle

Ritter (1991) identifies the long-term underperformance puzzle for the first time. With a sample of 1,526 IPOs in the U.S. during 1975-1984, he find the IPO shares were overpriced in respect of a three-year performance after going public, compared with their peer firms in terms of size and industry. In a three years' holding period, the return for 1526 IPO firms was 34.47%; however, the control sample firm's holding period return was 61.68%. Ibbotson (1975) finds the phenomenon earlier, but did not identify it as a puzzle. Ibbotson examine the holding period return for a ten year period with a sample of offerings in the period from 1960 to 1969. He concludes that for the new issuing firms, there is "generally positive performance the first year, negative performance the next 3 years, and generally positive performance the last year". Buser and Chan (1987) also documented the underperformance. Using data for 1,078 IPOs from 1981 to 1985 in the NASDAQ/National Market System (NMS), they examine the holding period return for a two year period. The results show that their sample had a positive average initial return of 6.2% and the market-adjusted mean 2 years' return is 11.2%. Table 1.2 illustrates the difference of five years performances between IPO firms and their peers.[8]

Some researchers, however, report their concerns over the long-term underperformance conclusion. Barber and Lyon (1997) focus on annual, three-year and five-year returns, and argue that many of the event study methods applied to long

[8] Source: Jay Ritter, "Return on IPOs during the five years after issuing, for IPOs from 1970-2003", May 2005, http://bear.cba.ufl.edu/ritter

	First six months	Second six months	First year	Second year	Third year	Fourth year	Fifth year	Geometric Mean year 1-5
IPO firms	6.2%	0.3%	6.7%	5.3%	10.3%	18.7%	13.2%	10.7%
Size-matched firms	5.6%	6.2%	12.2%	14.7%	14.7%	17.3%	15.1%	14.8%
Difference	0.6%	-5.9%	-5.5%	-9.4%	-4.4%	1.4%	-1.9%	-4.1%
Number of IPOs	7307	7287	7307	7392	6769	6010	5108	

Table 1.2: Five year period performance of IPO firms in NYSE, 1970-2003

term performance are conceptually flawed and ultimately lead to biased test statistics. They consider two main issues in the research. Calculation of abnormal returns is the first. They argue that empirical studies on long-term performance should calculate abnormal returns as the simple buy-and-hold return on a sample firm minus the buy-and-hold return on the control sample, but not cumulative abnormal return. Second, they evaluate the methods of developing a benchmark performance for long run stock returns.

They find that among three methods of developing benchmark performances, which could be problematic. Taking the control sample firms as the benchmarks might lead to observed biases in the following three aspects: new listing bias, rebalancing bias and skewness bias. Kothari and Warner (1996) also highlight the flaws associated with calculating long-run returns, while they focus more on using the asset-pricing model of Fama and French (1993).

Teoh et al. (1998) examined the relationship between managerial factors and the long-term underperformance of IPO firms. The authors provide evidence based on this research that issuers with unusually high accruals in the IPO year experienced significantly poor performance. In addition, issuers with the most "aggressive" attitudes in earning management performed about 20% less well than the most "conservative" ones did.

After all, it seems that the long-term underperformance puzzle is not well understood yet. At least, existing researchers cannot rule out the possibility of regulation reasons, accounting standards, managerial factors and sample bias, all being important factors in this puzzle.

1.2.5 Undervalued or overvalued?

The fact that the price of IPO shares jumps about 10% to 15% on average higher during the first few days than the price in the primary market is widely accepted by academic scholars and practitioners. Meanwhile, it is necessary to compare the offer price or the trading price with their “fair values” to examine the question of whether IPO shares are truly underpriced. Clearly, the concept of fair value extends the comparison to a larger scale and leads to new arguments.

Purnanandam and Swaminathan (2004) define “fair values” by using the price multiples, including price to EBITDA (earnings before interest, taxes, depreciation and amortization), price-to-scales, and price-to-earnings. The control sample in-

cludes the non-IPO firms in the same industries. In addition, the authors choose the industrial peers with similar operating characteristics as the IPO firms. In all, there are 2,228 IPOs in their sample, collected from 1980 to 1997.

It is important to mention that according to the given criteria of the data sample, the IPOs are all non-financial firms and the offer price is greater than five dollars. It is not difficult to understand why financial firms are excluded from their sample, since the underpricing phenomenon is not obvious in the case of financial firms. However, it is not usual to exclude the low offer price IPOs from the sample. The author claims that low offer price IPOs ("smaller IPOs") are more likely to underperform in the long run, and that a sample including them might provide a lower overall estimate of the long term performance.

The results reveal that the IPO shares offering prices are systematically over-valued relative to their peer firms. The results show that in relation to the large capitalisation IPOs from 1980 to 1997, the median IPO is overvalued by 14% to 50%. Because of this result, the authors believe that the IPO investors are over-optimistic in earnings growth forecasts while ignoring profitability when pricing the IPO shares.

However, it is arguable that the research is not well grounded for the following reasons. First, the authors have not presented evidence to support the claim. The claim that smaller IPO shares underperform in the long term is not a widely accepted assumption. Second, excluding the smaller IPOs from the sample might potentially lead to a *de facto* sample bias in their study.

1.2.6 Bookbuilding and auction

Bookbuilding is a tailored mechanism for selling IPO shares. During the period when the book is open, bids information is collected from investors. At various prices, which are above or equal to the "floor price" set by the issuer, investors are expected to write down the number of shares they wish to buy. The process aims at tapping both wholesale and retail investors. The offer price is then determined after the bid closing date. According to the demand information provided by investors, the IPO shares are allocated to investors' accounts.

Only after the offer price is determined and the allocation has been done, the public trading of the shares is allowed in the secondary market. This process of issuing initial shares is called "bookbuilding" and it is generally believed that the key point of bookbuilding is the collection of demand information.

The following is the process of bookbuilding[9]:

- The issuer who is planning an IPO nominates a lead merchant banker as a "book runner".
- The issuer specifies the number of securities to be issued and the price band for orders.
- The issuer also appoints syndicate members with whom orders can be placed by the investors.

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[9] "About bookbuilding", www.lkpsec.com/website/Book%20Building.htm

- Investors place their order with a syndicate member who inputs the orders into the "Electronic book". This process is called "bidding" and is similar to open auction.
- A book should remain open for a minimum of 5 days.
- Bids cannot be entered at less than the floor price.
- Bids can be revised by the bidder before the issue closes.
- At the close of the bookbuilding period the "book runner" evaluates the bids on the basis of the evaluation criteria which may include: price aggression, investor quality and earliness of bids.
- The book runner and the company conclude the final price at which the issuer is willing to issue the stock and allocate securities.
- Generally, the number of shares is fixed, as the issue size gets frozen based on the price per share discovered through the bookbuilding process.
- Allocation of securities is made to the successful bidders.

The most frequently observed IPO mechanism is bookbuilding, while relatively few firms choose to use an auction. Google for example is one of the exceptions. In 2004, with help from William Hambrecht, Google launched its IPO by Dutch auction on the internet. The first day return was also as high as 17%. Nevertheless, the

auction method is rare. In financial markets, most of firms choose the bookbuilding method.

It is noteworthy that while various types of auction methods are powerful in selling most common goods, equities and financial derivatives, these fail to dominate the IPO market. Jagannathan and Sherman (2006) report that IPO auction methods have been implemented in most of the global markets in the past but have been replaced by the bookbuilding method in most of the markets over the last few decades. For example, Italy introduced the auction method in the 1980s and then abandoned it in 1986. The bookbuilding method was introduced in Italy in 1992 and soon came to dominate the market.

Up until now, the reasons for bookbuilding have been discussed in the literature, but no agreement regarding it has yet been reached in academic community.

1.3 IPO Practice: Worldwide Survey

When talking about IPO, we generally refer to the step taken when a firm is going to offer its shares, existing or freshly issued shares, to the public for the first time. IPOs are applicable in almost all the financial markets in the world; however, the way that firms offer their shares is restricted by local financial law and restrictions, and must follow the method which local investment banks operate. Sometimes the difference is so tiny that we can neglect it, whereas in some circumstance the difference is huge and determinant to the outcome of the IPOs, such as the corporate capital structures.

Further to IPOs in Europe and the U.S. market, Ritter (2003) summarises the recent development in both markets and points out the differences in practice of going public. Of these offerings, one of the major differences between the two markets in practice is the pricing mechanisms. The proportion of fixed-price mechanism IPOs is declining and the proportional of the bookbuilding mechanism is growing in the European market, while the bookbuilding mechanism has long been dominant in America. In the U.S., bookbuilding starts with setting a file price range. Then, underwriters launch the IPO roadshow process, which usually lasts for about two weeks. During the roadshow, institutional investors' demand information is collected by underwriters and then issuers and underwriters together decide the offering price in the primary market by incorporating the market information within their existing information set. If the demand from institutional investors is unusually weak or strong, underwriters can revise the price range, although they need to submit the revised price range to the Securities and Exchange Commission (SEC). The final price is usually decided the day before the start of trading. It is not necessary that the offer price should lie in the file price range. For example, the offer price could be 20% less or more than the filed price range, as Loughran and Ritter (2002) document. Statistically, one half of the prices are in the filed price range, while a quarter of the prices lie below and a quarter are above the filed price range.

Specifically, the French IPO market is characterised by "choosing freely". The government doesn't interfere with the way of selling shares in IPOs, and almost every

mechanism is employed in the French market, such as fixed price, auction and book-building. The fixed price mechanism usually refers to those scenarios where the offer price is decided before the market demand information is collected, which tends to lead to a lower level of underpricing than bookbuilding does (Loughran et al., 1994).

In Germany, according to Aussenegg et al. (2003), the IPO market uses a combination of bookbuilding with a liquid pre-IPO when-issued mechanism. For IPO shares, there is no market price before trading in the secondary market. According to Ritter (2003), the price of the IPO shares is typically decided seven trading days later than the setting of the price range. However, for other securities, such as U.S. Treasury securities, there may be active forward trading before the securities are *de facto* offered in the primary market. This kind of market, where investors can buy and sell securities in a pre-auction, is called "when-issued" market. In most of the IPO markets, there is no "when-issued" method because of prohibition by law and securities regulations. Yet this is not the case in Germany.

The interesting aspect of this combination is that bookbuilding in this combination no longer serves as a channel to detect investors' demand, although the function of bookbuilding in other circumstances is collecting investors' demands (Benveniste and Spindt, 1989; Hanley, 1993). In the German IPO market, the "when-issued" market has taken over the information collecting function, while bookbuilding mainly serves as a way of distributing IPO shares.

In addition, issuers are subject to a "quiet period" after IPO in the U.S. while in Europe, issuers are not. The "quiet period" refers to the 40 calendar days[10] after going public, during which affiliated analysts are prohibited from issuing recommendation reports. The "quiet period" is designed to avoid the possibility of investors being misleading by some powerful analysts.

Legal problems also are an important issue when we compare different markets. For example, Blom (1996), and Ebke and Struckmeier (1994)[11] list the differences among the U.S., U.K., Germany and Netherlands in the legal responsibility of IPO prospectuses for issuer, underwriter and auditors. In the U.S., under the Securities and Exchange Act of 1933, regarding the liability of prospectus it is clearly stated who is responsible for the completeness and correctness of the content. Any party involved can be sued for their delinquency. In addition, most issuers in the U.S. seek to avoid predicting future earnings in order to avoid potential lawsuits. The British case is slightly different. According to the Financial Services Act of 1986, the prospectus liability is limited to certain parties in the process of the offering, and each party takes limited liabilities, depending on the notion of whether the information provided is based on the principle of being "fair and reasonable".

In Germany, under the two acts of the Wertpapier-Verkaufsprospektgesetz and the Bőrsengesetz, underwriters are only liable for the securities offered at the is-

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[10] The quiet period was set as 25 calendar days before the year of 2002.

[11] According to the summary by Tjalling van der Goot (2003), since the original documents are in the Dutch language.

suance and when in their possession. As such, the auditors' liability is limited to 255,000 Euros per audit, regardless of any other factors. In the Netherlands, there is no specific law or regulation regarding IPO prospectus liability. Therefore, the liability is judged by the principle of tort law or misleading advertising. Because of this legal system, only nine lawsuits against auditors were reported during the 10 years between 1983 and 1992. By examining a sample consisting of 92 IPO cases in Amsterdam Stock Exchange, Tjalling van der Goot (2003) reports that legal risk is the reason why high prestige underwriters are not willing to get involved in risky IPOs in the Netherlands.

The shares offered are also different. In Sweden, most IPOs have dual-class shares and only the shares with fewer voting rights are sold to public. Holmėn and Hőgfeldt (2005) argue that this is the result of the Civil Law legal system because of the centralised nature of political issues and the legal regime, while in a Common Law system, the procedures are decentralised. They believe the legal system is the reason why the dual class shares are issued and as a result, the control means shareholders' rights are over-protected, while the small shareholders' rights are neglected. This is also shown in the following statement of the new Swedish Corporate Law[12]:

"The use of shares with different voting rights has a long tradition in Swedish law. Dual-class shares are very common among listed companies in Sweden. The dual-class share system has significant advantages. It makes it possible (facilitates) to

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[12] Translated by Holmėn and Hőgfeldt, 2002.

have a strong and stable ownership function even in very large companies. Thereby creating the necessary conditions for an efficient management as well as for the long-term planning of the firm's activities. Shares with different voting rights also facilitate for growing companies to raise new capital without the original owners losing control. There is no evidence that the dual-class share system has caused any noticeable negative effects....Dual-class shares can significantly promote the efficiency and development of individual firms as well as of the business sector in general."

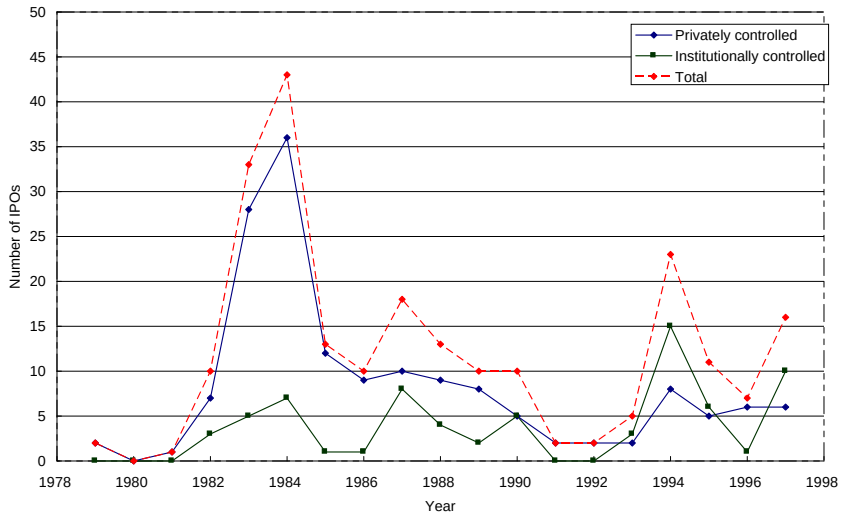

Figure 1.4: Frequency of IPOs on the Swedish Stock Exchange between 1979 and 1997 (Source: Holmén and Högfeldt, 2005)

According to Jagannathan and Sherman (2006), the regulators for Israel's IPO market assign auction as the only permitted offering method for a decade prior to December 2003, and the prohibition of the bookbuilding method is currently still banned. The change in regulations directly resulted in the consequence that there has

been no equity IPO since 2003. In Turkey, Istanbul Stock Exchange (ISE) introduced auction as the way of dealing with IPO for the first time in 2003. Meanwhile, book-building, fixed price offers, sale through stock exchange and hybrid offerings are the mechanisms used in equity offerings (Kucukkocaoglu, 2006).

In the Asian IPO market, up to my knowledge, there are few surveys on the difference between IPOs in this area. As most Asian financial markets are premature and changing through time, it could be inspiring when we look at the changes experienced by these financial markets.

Kutsuna and Smith (2004) document that in Japan, the bookbuilding method of IPO was first introduced as an alternative choice for equity offerings in October, 1997. Before this, a discriminatory auction method was assigned as the only required method for IPO since 1989. The auction method in Japan is a hybrid of discriminatory auction and fixed price offering. About a half of the offering shares are sold by discriminatory auction and the rest are sold at a lower price than the weighted average price in the auction to the public. It is notable that within only one month of the change of regulations, all issuers in Japan chose bookbuilding as the preferred way of offering. Kutsuna and Smith (2004) believe that in this shift of regime, the pricing accuracy of IPO shares was improved. It seems that the overvalued firms rushed to go public before the new system was introduced, since the number of IPOs in September, 1997 is 25 comparing to 12 IPOs in October, 1997 after the bookbuilding method was available. However, if the total issue cost is measured as the percentage

of trading price, the average issue cost of IPO in the bookbuilding mechanism is on average higher than in the Japanese auction method. The issue cost can be interpreted as the cost of a better price and market efficiency.

Chun and Smith (2000) document the South Korean finance market in recent years. Compared to their peers in the U.S., Korean firms rely more on debt finance and thus on having a high debt ratio. In South Korea, private firms are not able to get debt finance easily, thus the equity financial market provides them with the opportunity for equity finance. Meanwhile, going public opens up a channel for firms to gain public information and encourage outside financing, such as commercial loans or equity investments. The cost of IPO in South Korea is reported to be about 3% of gross proceeds.

As described by Shah (1995), the Indian IPO market is characterised by the following features. First, the Indian IPO market has high average underpricing with 105.6% of the documented data. It is worth mentioning that the underpricing level is quite surprising. Second, the time taken between issue date and the date of trading in the secondary market is very long, compared to other markets. The typical length of this period is 11 weeks, and it varies from case to case subject to the size of the IPO and the market. Third, the first year returns on IPOs are outstanding in the market. On average, investors can earn 40% excess return by holding IPO shares for the first 200 trading days than holding market index linked funds. The statistical out-performance of IPO shares in the first year is a quite unique phenomenon among

the world financial markets. The author believes the excess return may reflect the manipulation of trading in the market and more fundamentally the weak financial governance, although there is not enough evidence to support this hypothesis.

Among the global financial markets, China has the most severe documented IPO underpricing level. Yu and Tse (2006) document that in the sample of 343 IPOs during 1995-1998, the average underpricing level for A shares[13] IPOs is 123.59%. This is consistent with other empirical studies performed by Ma and Faff (2007). In exploring the phenomenon, Su and Fleisher (1999) describe some distinguishing characteristics of new issue shares in China in the 1990s. First, the State Planning Commission, the People's Bank of China (central bank) and the China Securities Regulatory Committee (CSRC) determine the annual quota for IPO capitalisations and volumes. Then the quota is allocated to provinces according to their capital demand. The firms are selected in respect of their business strength and the local development goals for achieving the right to go public. Second, only the shares that are not retained by government and other state-owned enterprises and employees are permitted to be traded in the secondary market.

On the aggregate level in the market, there are five types of shares for a firm: government shares, legal entity shares, employee shares, ordinary domestic shares (A share) and foreign shares. Among these, the first three types of share are sold at the book value of a firm's total assets and are not allowed to be traded. Employee

[13] There are two types of shares in China domestic financial market: A shares and B shares. A shares are traded with domestic currency RMB for domestic investors and B shares are traded in the U.S. dollar for foreign investors.

shares are allowed to be traded only after three years' listing. There are two kinds of foreign shares, although all foreign shares are designed for foreign investors and are in foreign currencies. One kind of foreign shares, called B shares, is traded in domestic markets while using the U.S. dollar. The other foreign shares, called H shares, are traded in Hong Kong, in Hong Kong dollars. The unique regulations and arrangement of Chinese firms are no doubt part of the reasons for the severe underpricing level. It is worth mentioning that among Chinese new issues, the ownership is one important factor in the IPO performances. Chau, Ciccotello and Grant (1998) and Mok and Hui (1998) provide some supportive evidence that suggests that IPO underpricing is smaller for firms that have retained more government ownership.

1.4 Theoretical Studies Review

It must be painful for the issuers if they believe that they are losing money from the IPO underpricing, given that the underpricing level is quite significant. Although it seems that it is not necessary for issuers to underprice the offering shares significantly, the issuing firms do leave huge amounts of money on the table for the new investors in practice. The questions here are obvious. Is it possible that the issuers would be able to retain the money if they did not underprice the shares? And what is the right price for the shares in the primary market?

If the fair price of a share is greater than the offer price in the primary market, the issuer is losing money. Assuming that issuers are rational, it seems that once

issuers realise they are losing money, they should raise the offering price and thus stop losing money. However, this is not true in the real world. According to Loughran and Ritter (2002), and given the fact that during 1990 to 1998 companies going public lost $27 billion during the IPO, neither issuer nor underwriter subsequently tried to raise the offer price. A careful investigation revealed that during the same period, $13 billion, only half of the money lost, was paid to the investment bankers for the issue fee; and also $27 billion was a bit more than the issuers' accumulated profit over three years. More interestingly, issuers do not think that the reason for the underpricing is that the underwriters are incapable of pricing, as evidence suggests that many investment bankers will serve again as underwriters in the seasoned public offerings.

Aiming at making sense of the puzzling evidence, Loughran and Ritter suggest some reasons. First, most IPOs leave relatively little money on the table when going public. The anticipated price of the IPOs that do leave a lot of money is lower than the market price, and hence they discover their wealth during the process. Second, since the offer price only adjusts partially to public information, first-day returns are predictable. Third, the IPO underpricing can be explained as an indirect form of underwriter compensation, because investors are willing to gain favourable allocations on hot deals. The pricing of IPO shares in term of this theory is a bargaining process.

Yet Reuter (2006) argues that the reason for this sale and underpricing is that it is a part of selling strategy. Reuter believes that the central question of under-

pricing is whether underwriters use their discretion over IPO allocations to reward investors while issuers' proceeds are reduced. This question reveals the conflict of interest between underwriters and issuers. He investigates the allocation of underpriced shares in the IPO by collecting the allocation data across mutual fund families between 1996 and 1999. Since the IPO allocation data was not publicly available, this research chose to use the reported mutual fund equity holdings from the same period to infer the allocation data which is unique. After all, Reuter finds evidence that suggests the link between reported IPO holdings of mutual fund families and the level of the brokerage commission payments from the mutual fund families to lead underwriters was significant. According to the author's estimate, mutual fund families in the U.S. have received as much as two fifths of the total money left on the table. Overall, this theory highlights the particular agency conflict between underwriters and issuers and points out that the fundamental problem of underpricing is the agency's conflict of interest.

Cornelli and Goldreich (2001) believe that although the underwriters vary the allocation of IPO shares among different investors, the reason for the allocation is not conflict of interest with the issuer. Their research is based on a unique set of book-building data consisting of 39 international equity issues, although most "books" are kept private by underwriters, and the details of bid information and allocation information are unknown to the public. The advantage of this evidence is that it gives the authors the privilege of examining closely the IPO-related questions, such as whether

the bidders who reveal information are favoured in the allocation of the IPO shares. This research provides the following explanations for the puzzles. First, investment bankers reward bidders who reveal more information by allocating them more IPO shares in primary market. Second, bidders who participate in a large number of issues receive favourable allocations from underwriters. However, there is no evidence to suggest that the favorably treated investors earn abnormal profits more often than other investors. The findings suggest that investors are compensated for their exposure to risk. Hanley and Wilhelm (1995) report similar research investigating the allocation problem with 38 cases. Jenkinson and Jones (2002) document the allocation problem with 29 IPO cases.

The follow-up research by Boehmer and Fishe (2004) using a larger data sample supports this argument. Boehmer and Fishe analyse 1.56 million accounts in 265 IPOs in order to investigate the relationship between underwriters and investors, and the result is consistent with the previous findings (Figure 1.5)[14].

By and large, there are three major arguments involved in underpricing: behavioural finance, information asymmetry and institutional agreement. We survey these arguments as well as some other factors, such as legal problems, in the rest of this section.

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[14] Adapted from Boehmer and Fishe, 2004.

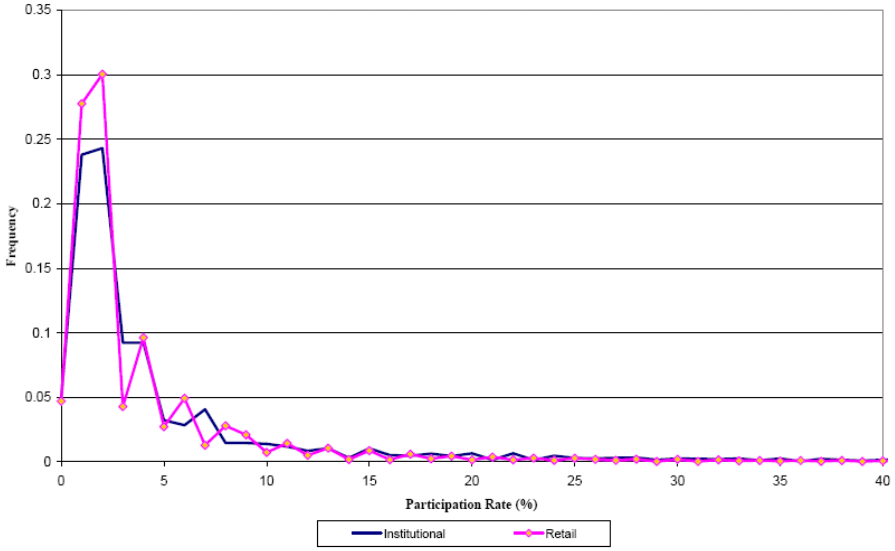

Figure 1.5: Distribution of participation rate for institutional and retail investors.

1.4.1 Irrational investors: behavioural finance theory

One of the mainstream explanations for the IPO-related puzzles is that the investors are sentimental. Investors in general may be on average over-optimistic regarding the newly traded shares, based on the analyst's reports, or over-pessimistic regarding those shares with insufficient analyst reports or recommendations. After all, investors do not make investment decisions solely on the quality of the underlying assets or expected cash flows, as we have learnt from classic economics textbooks. Issuers and underwriters thus have to make great efforts to send out good messages in the public media, such as newspapers. Analysts affiliated to the underwriters also try to send out positive information and higher price predictions to the public in order to reduce the underwriting risk of their employees. Since the majority of public investors are

insufficiently informed by true information about the firm, the majority of the public cannot know the "fair" price of newly offered shares. As the consequence, intensive media coverage must result in a higher trading price of the IPO shares in the secondary market.

The sentimental investor's story seems to explain everything we observe in the real world about the IPO of shares. The critical part of this story, however, is that the assumption of investors is contrary to the classical theory in financial economics, that of the rational investors' assumption. This difference leaves some space for another theory, behavioural finance, to explain. The behavioural finance theory argues that in some circumstances the economic phenomena could be better explained with models that assume the agents are sentimental to some extent, instead of fully rational.

In a famous survey of behavioural finance literature, Barberis and Thaler (2003) summarise the main features of behavioural finance theory. This theory analyses the scenarios with two presumptions. The first one is that of the limited arbitrageur, which argues that rational traders can not easily cancel the misallocations of funds by less rational traders; the second presumption is of psychological bias, which explains the observed behaviour deviations from those fully rational expected. In addition, the authors emphasise that under the limited arbitrageur assumption, rational investors' rational investment, such as arbitrage, might seem very risky. Hence, if the market is efficient, and the price is right there will be no arbitrage opportunities; if the market is inefficient, the price will not be right and there might still be no arbi-

trage opportunities. If this is the case, limited arbitrage might be the explanation of IPO underpricing puzzle.

Two supporting sources of evidence for behavioural finance theory are well discussed in the following literature: "hot market phenomenon" and long-term underperformance.

"Hot market" refers to the period when the underpricing level of IPO shares is significantly higher than during a normal period, which was recorded by Ritter (1984) for the first time. Ritter investigated the IPO market in the U.S. from 1977 to 1982, and found that from January 1980 to March 1981, the IPO shares were on average (equally weighted) underpriced by 48.4%. Yet, in the rest of the time during the investigation period, the average underpricing level was at 16.3%. Moreover, the greatest underpricing IPOs are clustered in the natural resources industry. If the IPOs in the natural resources industry are isolated, the hot market becomes insignificant. According to Ritter's calculation, the underpricing levels for non-natural resource IPOs were on average at 21.0% in the hot market period, and 15.8% outside that period. However, the natural resource related IPOs were underpriced on average by 110.9% during the hot market and 18.3% during the cold market.

Ritter (1991) discovered long-term underperformance for the first time. By analysing a sample of 1,526 IPOs in the U.S. market during 1975 to 1984, he discovered that the firms going public significantly underperformed compared with their peer firms by size and industry. This anomaly is of theoretical interest, if it is veri-

fied, for the following reasons which Ritter listed in his paper. First, systematically overpriced IPO shares leave a space for the arbitrageurs to arbitrage from this mispricing in the market. Second, the issue about market efficiency in the IPO market is questioned according to this test result, and the evidence itself supports the newly developed theory about behavioural finance. Third, the volume of IPOs with large variations may be associated with long-term performance.

Some other evidence shows that long-term underperformance is usually associated with IPO shares. Stoll and Curley (1970), Ibbotson (1975) and Stern and Bornstein (1985) suggest that the abnormal IPO return might be negative in most cases. Meanwhile, there are also some conflicting empirical findings, which undermine the credibility of the underperformance puzzle. For example, Ritter (1991) reports that the underpricing is negatively related to the long term underperformance. However, in a research that focused on the flippers by Krigman, Shaw and Womack (1999), and using a data sample of IPOs from January 1988 to May 1995, it is reported that the relationship between underpricing and long term underperformance is positive. Moreover, Affleck-Graves et al (1996) examined the relationship between underpricing levels and the three-month returns and also found it is positive.

In the behavioural finance model, as summarised by Barberis and Thaler (2003), the following risk characteristics are taken into consideration. First, fundamental risk refers to fundamentals and is subject to the management of the firm, the industry, macroeconomic factors and other related policies, etc. Second, is noise trader risk.

The noise trader risk was introduced by De Long (1990) and was further developed by Shleifer and Vishny (1997). This type of risk refers to short run mispricing when noise traders are trading actively. Even if the substitute of one stock exists, the arbitrageurs might still face this risk. Noise trader risk is important and arbitrageurs might be forced to liquidate their positions in some circumstance to limit their loss in a certain position, although the positions might be correct in the long run. Therefore, the right decisions bring arbitrage losses.

The liquidity problem is partly due to the agency problem, which is essential from the contractual view of the firm. Here the agency problem refers to the problem caused by the separation of ownership and control. The management allocates funds to productive use, while the investors use the management to generate return on their funds. In this setting, the problem arises: how can investors be sure that management efficiently allocates their money to generate returns, but does not waste the money? In order to solve this agency problem, the investors choose to retain the option to liquidate their holdings when there is an unexpected situation, such as abnormal variance in the market. The option to liquidate holdings limits managers' rights in allocating resources to risky assets. This problem is a so called "separation of brains and capital" (Shleifer and Vishny, 1997).

Third: implementation costs. The implementation cost refers to the cost of transactions during the trading, such as commissions, ask-bid spread and so on. In theory, it is expected that implementation costs are small; however, they are not eas-

ily ignored in the real world. In his research into the market for borrowing stock, D'Avolio (2002) found some evidence. The good thing is that most stocks are shortable (available for "short" trade) in empirical research. Only those illiquid stocks may be potentially impossible to borrow, which accounts for 16% of all stocks. The bad thing is that the transaction cost is significant. Ninety-one per cent of the stocks borrowed generate loan fees of only 17 basis points annually, while the other 9% generate loan fees for 4.30% annually. Given that the arbitrageurs wish to eliminate their risks in real time, the transactions for hedging risk is enormous and the transaction cost would be considerably greater. Besides the transaction cost, for the majority of fund managers, short selling is just not allowed. Such borrowing fees and restrictions on stock borrowings must have prevented the low return arbitrage activities, which ultimately damages market efficiency.

Besides the market situation, the behaviour models are also backed by psychological explanations. On the one hand, people's beliefs might differ from the facts that they can actually see. There are many aspects of the strange beliefs in people's minds. One is overconfidence, either being too confident in their beliefs or overestimating the probabilities of good scenarios. For example, as Fischhoff et al. (1977) recorded, the events which, definitely will happen, in people's minds actually only occur about 80% of the time while the events people believe will never happen occur around 20% of time. People will also be prone to overconfidence after a period of success. One other aspect is optimism and wishful thinking. Weinstein's (1980)

research shows that most people's view of their own abilities and prospects are over-optimistic. The remaining aspects include representativeness (Kahneman and Tversky, 1974; Gilovich, Vallone and Tversky, 1985), conservatism, belief perseverance (Lord, Ross and Lepper, 1979), anchoring and availability biases (Kahneman and Tversky, 1974).

Although this experimental evidence and other psychological theories might be helpful for economists, however, we must be cautious and careful in implement the psychological theories within economic research for the following reasons. Where there are economic incentives, people are less likely to be affected by psychological factors. Professional investors or analysts making significantly fewer biased judgements than ordinary people. People try to avoid their biases when they realise they have biased minds. Finally, yet importantly, those biases are not going to happen all at the same time and we cannot say which one is working and when.

On the other hand, how people evaluate the risky aspect of assets is a critical problem. This is essential for most of the models used in finance theories. Most of the theories assume that investors evaluate the risky assets according to their expected utility since Von Neumann and Morgenstern (1947). According to the expected utility function, the basic requirements are completeness, transitivity, continuity and independence. In reality, however, much evidence suggests that the investors do not follow the expected utility functions. Consequently, many efforts have been made to develop a better function to describe people's evaluations, such as weighted util-

ity, implicit expected utility, disappointment aversion, regret theory, rank-dependent utility theories and prospect theory.

Focusing especially on prospect theory, Loughran and Ritter (2002) developed prospect theory as applied to IPO underpricing and Ljungqvist and Wilhelm (2003) tested this theory. Ljungqvist and Wilhelm find that controlling for other known factors, IPO firms are less likely to change their underwriters for the seasoned equity offering. This empirical evidence can be interpreted as suggesting that those issuers are satisfied with the IPO underwriters' service. Consistent with Loughran and Ritter's argument, Ljungqvist and Wilhelm believe that underwriters participating in IPOs can gain from the decision-maker's behavioural bias, in the same way that institutional investors can profit from unnecessarily underpriced shares and share the profit with underwriters. The underpricing level of the IPOs with which issuers are satisfied is on average 41.4%, while the rest are at the level of 6.1% on average.

Meanwhile, the chances are that we do not know at all what will happens the next day, never mind a while later. We also need to face this ambiguity in the finance theories. Investors never objectively know the probability of the outcome of investments. Ellsberg (1961) performed an experiment on the nature of investors' aversion of ambiguity. The experiment suggests that besides the expected outcomes, people do not like being in a situation where they do not know the probability distribution of the outcomes. Knight (1921) discussed this problem and believed that investors dis-

like uncertainty, and Savage (1954) later developed a theory to describe subjective expected utility.

1.4.2 Information asymmetry theory

Since IPO firms, usually characterised as young and premature, are usually less well-known to the financial market before their IPO, gaining information about them is one of the most critical problems for their going public. Moreover, compared with their peers, but existing publicly hold companies, investors will have no information on the historical price series of a newly public firm. This might also be one of the reasons for the puzzles that surround IPO shares.

One stream of theories is called adverse selection theory. Some papers, such as Rock (1986), argue that information asymmetry occurs between different investors. In response to prior research by Grossman (1976), Rock believes that the assumption that superior private information can be obtained from the publicly observed equilibrium price ultimately leads to a paradox. In his paper, Rock proposes another assumption that only when the market price cannot reflect the true value of the stocks, can the insiders profit with their private information by trading the "mispriced" securities. In the model, he discusses the reasons why the issuer is not fully informed about the price of the shares, although they know a significant amount about the future of the firm. First, the firm publishes its knowledge for the market in the IPO prospectus, and the underwriters certify that this revealed information is fair by their

reputation. Second, the investors in the market in many ways may know the market better than the firms do, although the underwriters and the firms may have superior information. This leads to an adverse selection being made among the investors, similar to Akerlof's lemon market (1970). Only the informed investors will ultimately profit from IPO shares in this game. Beatty and Ritter (1986) and Carter and Manaster (1990) have the similar findings.

Another stream of theories, such as those of Allen and Faulhaber (1989) and Grinblatt and Hwang (1989), suggest that the information asymmetry is between investors and issuers. They assume that the most informed participant in the offering is the firm itself. In their model, there are generally two types of firms: good firms with a higher expected dividend flow and bad firms with a lower dividend flow. However, since the firms are normally new and only the firm itself knows its type, investors can hardly tell the difference between those two firms. Investors can only observe the price and the proportion of the firm sold in IPO and the dividends at the end of each period. The consequence of this setting is that the good firms send out a "good" signal by low IPO prices hoping to "leave a good taste in the investor's mouth". As supportive evidence, Welch (1989) reports that about one-third of IPO firms between 1977 and 1982 made their seasoned offerings by 1986 and the typical amount of money raised was at least three times the initial offering. This is typical evidence suggesting that the existing shareholders are willing to underprice their shares in order to send out this signal. If the firm can perform well, the trading price of the shares will

rise eventually, and shareholders can sell their shares at a fair price at the end. Yet existing shareholders will have no chance to sell at a higher price if the firm cannot perform well enough.

Michaely and Shaw (1994) test the implications of the winner' curse and signaling based models with a sample of IPOs from 1984 to 1988. The question for the research was simple: are the informed investors compensated by underpricing according to the information, or do the issuers need to pass the information of the underlying asset by underpricing? The empirical result suggests the adverse-selection models are more reasonable and fit the data, while the signaling story is little supported.

Sherman and Titman (2002) show that the underpricing of IPO shares is a form of compensation for investors' information acquisition costs, since the investors themselves do not have the information freely available. In the model, they emphasise that the underwriter can select a group of investors along with the price and the allocation mechanism. The purpose of this selection is to maximise the information gathered during the process of IPO. When the information creating process is costly, the only way the underwriter and the issuer can compensate is to lower the offer price. In their model, if the information is less costly, the number of investors in the primary market will be infinite and the underpricing level will be about zero. On the other hand, when the information is extremely expensive, underpricing of IPO shares will be at a very high level to compensate for the information cost. Meanwhile, the under-

pricing level is subject to the demand for accurate information. Greater underpricing will be set to introduce more investors to acquire more accurate information. The supportive evidence from James (1997) suggests that the underwriters form investor groups to repeatedly participate in IPOs.

Schenone (2004) presents a different view that the information about underlying assets is ambiguous, and he believes that sometimes the information is just insufficient and underwriters can not get the right price. However, if the underwriters had a better knowledge of the issuer and its quality, they would have a better idea of the price in the primary market. Evidence from banking relationships supports this theory, showing the existence of information asymmetry between underwriters and issuer. Schenone tests this theory on a sample of 1,245 firms going public from January 1, 1998 to December 31st, 2000 in the U.S., and finds that a pre-IPO banking relationship reduces the asymmetric information for the underwriters for the firms going public. In addition, the evidence reveals that a well-established banking relationship can reduce by 17% underpricing level for an issuer.

One of the consequences of information asymmetry is that the acquiring information is costly. In order to explore the information about the market and the issuers, someone has to be the pioneer and pay the cost of collecting precise information. Benveniste et al. (2002) believe that if the pioneer firms going public paid the primary cost, because market failures can happen, no firm would want to be a pioneer. The consequence of market failure is that both "pioneers" and "followers" remain

private and the investment decisions made are not efficient, due to the lack of information. They argue that in reality underwriters can solve this coordination problem on industry sector level. In addition, IPO clustering is one of the by-products of information asymmetry. It is noteworthy that, the firm itself has its reservation price for the offering. The reservation price is kept secret, and firms will withdraw the going-public application if the expected market price is lower than the reservation price (Brisley and Busaba, 2007).

1.4.3 Shareholder agreement theory

Since some of the shareholders are actively involved in managing companies in general, the shareholders may form some agreement on the managerial issues, especially the issues about financing. The use of shareholder agreement theory in explaining IPO-related puzzles has been discussed for the first time by Bernstein (1988).

As Chemla et al. (2007) summarised, the shareholder agreement theory mainly focuses on the following four issues. First, shareholders' concern about the option of putting existing shareholder's stakes to their business partners. Second, the shareholder may ask for the same treatment for their partners, "tag-along rights". Third, shareholders may initiate a sale and force their partners to join them in selling, "drag-along rights". Fourth, shareholders may force other shareholders to agree on going public, "demand rights". As such, the shareholder agreement theory is relevant to the

decision of going public and hence may be of importance in exploring the nature of IPO-related puzzles.

Further to the underpricing puzzle, agreement theory is based on the assumption that the existing shareholders want to introduce new target investors to achieve their goals. In this sense, the underpricing is purposeful as it serves to attract more investors and helps select the most desirable ones out of numerous investors.

The intentions of introducing target investors could be two as follows. The first reason is to attract investors who are able to aid in acquisitions that are financed by the IPO. Brennan and Franks (1997) examine a sample of 69 IPOs in the UK and find that underpricing was being used to ensure oversubscription. Evidence suggests that in a seven year period after going public, directors sell only a modest fraction of their shares, while most non-directors sell off their holdings. Consequently, up to two thirds of the shares have been sold to public investors in the period and increasing the separation of ownership and control. Meanwhile, the issuers discourage investors from applying for large blocks in the IPO share allocation. In the seven years' period after going public, evidence suggests that a larger underpricing level leads to smaller block holders. In a ten-year period after going public, there is a low level of hostile takeovers, suggesting that the underpricing strategy is successful in preventing hostile changes of control.

The other intention is to attract investors who are more likely to be favourably disposed to the firm's business or methods of management. Stoughton and Zechner

(1998) analyse the influence of the IPO mechanism on the shareholder structure. By providing a model of the agency problem, they explore whether the role of underpricing determines the shareholder structure. Taking the underwriters as the active brokers in the institutional investment community, they show that the offering of shares could bring benefits to the entrepreneur in two ways. First, underwriters are able to distinguish those investors who can monitor the management and provide them with favourable allocations in the offering. Second, underwriters change the one time offering to a repeated game and thus are able to negotiate directly with large investors for a better deal for the issuer.

Beside those two purposes, the shareholders hope to disperse the ownership structure. Booth and Chua (1996) argue that the underpricing is the result of the demand of the issuer for a dispersed shareholder structure and secondary market liquidity. In the research, the authors report the evidence showing that the underpricing is positively related to the degree of ownership dispersion. In addition, Stoughton and Zechner (1998) argue that underpricing allows a change of ownership such that the possibility of shareholders' monitoring on management is increased.

Dawson (1987) points out that the underpricing may be more severe than expected, if taking the dilution effect of offering new shares is taken into consideration. If underpricing did not exist, the market price of the offering shares could be higher than is the case when underpricing does exist. As a result, it is necessary to implement a new measure of "issuer-oriented underpricing". Under the new measurement,

the underpricing level is always greater than the current perception suggests. The wealth transfer in IPOs due to underpricing may; however, not be as significant as would be expected under Dawson's measurement. Barry (1989) points out that the transfer of wealth involved in underpricing is less severe. As the existing shareholders participate more actively and sell their shares, the transferred wealth increases.

After all, the selection of target investors will increase the value of the firm. Unlike the case with the information asymmetry and sentimental theories, this kind of underpricing is an artificial one and the issuers to some extent control the degree of underpricing.

1.4.4 After-market stability and liquidity

One of the most important results of being a public trading firm is the increased liquidity of its shares, and it is therefore essential to explore the relationship between the liquidity of shares of the underpricing level.

Generally, people perceive that a large trading volume is contributed by individual investors, or "flippers". Aggarwal (2003) quotes from the Wall Street Journal, "Traditionally, individuals get between 10% and 20% of IPO shares at the offer price". Additionally, he presents evidence that the trading volume is indeed high in the first few trading days in the secondary market for IPO shares. However, it seems that flippers are not the main reason for the large volume. With respect to the IPO shares' trading volume in the secondary market in the first few days, individual

investors contribute 19% of the trading volume, and 15% of the share volume. However, institutional investors flip most of the shares in hot IPOs while their activity is relatively lower in cold IPOs. Aggarwal interprets this phenomenon as meaning that the institutional investors do not flip the shares in cold IPOs in order to support the underwriters' favourable allocations. In general, Aggarwal (2000) points out that the after-market trading is less transparent and includes stimulation of demand. The major channel for demand stimulating is through short covering while the channel for restricting supply is by penalising the flipping of shares. From the observations, we can conclude that individual flippers are not included in the penalisations, considering that it is both difficult and costly to identify individual flippers during sequential offerings.

Ellis, Michaely, and O'Hara (2000) emphasise the relationship between underwriters and market makers in respect of the after-market liquidity. They find evidence that the lead underwriter is always the dominant market maker because of taking substantial inventory shares. In a cold or "less successful" IPO, the lead underwriters use their inventory to stabilise the after market trading of IPO shares. The underwriting fee is definitely the primary incentive for underwriters to become involved in the stabilisation activities, while the after-market trading also generates profits at most of the time.

In some other markets, however, the underwriters do not perform as active market makers, or are unable to be the market maker. The underpricing of IPO shares

is therefore not a source of compensation for the underwriters, but may compensate investors. As the precise after-market liquidity is unknown to the public investors, the level of underpricing may substantially reflect the risk of the uncertain liquidity level. Ellul and Pagano (2006) provide a model showing that higher underpricing levels are always associated with greater than expected illiquidity or a high liquidity risk from the perspective of adverse selection. Using a data sample from the London Stock Exchange (LSE) between June 1998 and December 2002, they employed high frequency data to identify the directions of trading in the after-market of IPO. The empirical test indicates that the relationship between the underpricing level and the after-market liquidity level and the liquidity risk is robust. Moreover, it shows that the secondary market liquidity does affect the cost of the equity capital for companies when going public. Figure 1.6 illustrates the empirical result of average adverse selection in the year after IPO.[15]

Further to the relationship between after-market liquidity and the underpricing puzzle, Zheng and Li's (2007) findings support the hypothesis that underpricing is significantly related to the secondary market liquidity. In their research, the regression is performed using the sample of 1179 IPOs in NASDAQ market, and the authors control the variables of ownership structure and other factors in the regression.

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[15] Reprint from Ellul and Pagano (2006), Figure 2.

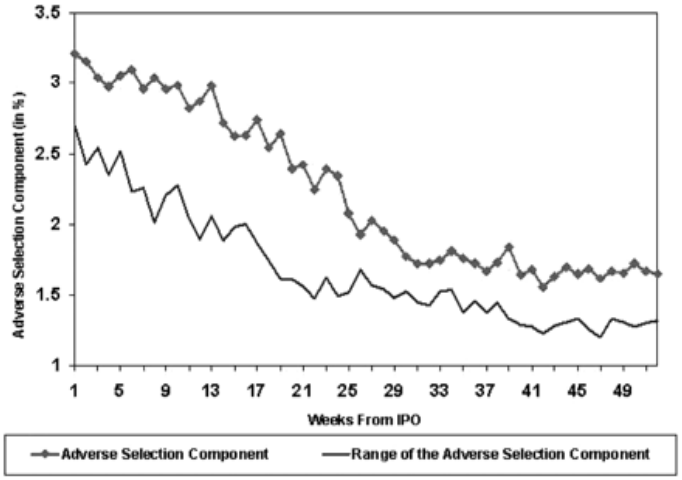

Figure 1.6: Average adverse selection component of the bid-ask spread and its range of variation in the year after IPO

1.4.5 Litigation risk

The litigation risk is generally considered when signaling theory and information asymmetry theory are applied to the underpricing puzzle. (Ibbotson and Jaffe, 1975; Brown et al., 1988; Hughes and Thakor, 1992; Ibbotson, Sindelar and Ritter, 1994; Beatty and Welch; 1996, Lowry and Shu, 2002).

Ibboston and Jaffe (1975), Brown et al. (1988) describe the underpricing as a form of insurance against future liability, the price of the insurance being determined by the potential damage that a lawsuit would cause and the possibility of a lawsuit happening. The level of underpricing increases as the damage and possibility increase. Lowry and Shu (2002) continue to investigate the legal problem with two specific hypotheses. First, firms with a higher litigation risk also have a higher level of underpricing. The underpricing thus can be treated as a form of insurance for the

investors. Second, a higher underpricing level leads to a lower expectation of litigation costs. The results of the analysis support the authors' hypothesis. If this is true, the underpricing is in some sense a preestablished compensation for the litigation risk and insurance against potential damages.

With the same question in mind, Dunbar et al. (1995) find that available assets are a better predictor of settlements than is potential damage. These findings suggest that companies going public are susceptible to frivolous lawsuits, which are essentially difficult to avoid despite due diligence prior to the IPO. Therefore, the authors conjecture that companies might resort to using underpricing as a form of insurance, thus decreasing potential damages and lowering the probability of a lawsuit.

Drake and Vetsuypens (1993) focus on cross-sectional analysis of legal issues in the offerings. They compared 93 IPO firms which were sued with a sample of non-sued IPO firms, matched in respect of the year, underwriter rank, and offer size. The authors conclude that the average initial returns of the sued firms were greater than those of non-sued IPO firms. Further, the authors compare IPOs with positive initial returns to those with initial returns less than, or equal to, zero, and find that a greater portion of IPOs in the first category is sued. The empirical results imply that sued firms are not systematically overpriced, and the results are inconsistent with the litigation-risk hypothesis. Yet, critics argue that the analysis might be flawed as it suffers from an endogenous problem.

Keloharju (1993) examines the underpricing of IPOs in Finland, where there is negligible litigation risk. Evidence suggests a mean initial return of 8.7%, despite essentially zero potential legal liabilities associated with the IPO. This finding suggests that expected litigation costs cannot explain all of the initial returns. Yet it provides little additional information on the legal risk in other markets, given that the legal environments for IPO are substantially different. As Keloharju mentions, mean initial returns are significantly higher in the U.S. market, which is possibly the result of different litigation risks there.

Some specific studies have been performed in respect of different areas and some specific laws. Beatty and Welch (1996) investigates the legal liability under the Securities Act of 1933 (the U.S.), which requires issuers who seek to offer shares to the public to register with the Security and Exchange Committee (SEC). Section 11 of the Securities Act of 1933 specifies that all the relevant parties in the offering, including auditors, underwriters, issuers, persons signing the registration statement and other experts, are jointly liable for damages caused by fake or misleading information in the IPO registration statement. A judgement that an expert has violated the relevant law means the expert is exposed to the entire damages award for the relevant parties. Thus, the experts are linked to each other with respect to legal liabilities and it is reasonable to require compensation for the legal risk. As Section 11 requires "reasonable investigation", Section 12 of the Securities Act of 1933 requires "reasonable care". In Section 12, issuers are required to refund the securities at the price of

purchase if damages have been awarded. The authors implement a unique perspective in the sense that they show that all participating lawyers in initial public offerings have to disclose their compensation. They find that in the 1990s, high-quality lawyers were better paid, while their peers in the 1970s and 1980s had been paid only about as much as low-quality lawyers were paid. Further, high-quality lawyers can reduce IPO underpricing and underwriters' compensation for smaller issuers. Finally, they find that unusually high payments to underwriters are oddly related yo an unusually low number of risks described in the IPO prospectus and higher underpricing level on average. The implication of this finding is that although the offering risk might not usually be associated with the underpricing level, it could be a significant influence in some extreme cases.

Jones and Weingram (1996) investigate the determinants of securities lawsuits filed under Section 10(b) from the perspective of law in the U.S.. They find that variables that enter into shareholder damage formulas, including the proportion of shares traded, firm market capitalisation, and the share price declines, all contribute to litigation exposure.

Alexander (1991) examines 17 computer-related IPOs in 1983 and discovers that securities lawsuits are more likely filed when the value of the *ex post* stock price decline was sufficient to support the fixed cost of bringing a case. The research further indicates that apparently the ratio of shareholder losses to settlements of lawsuits varies little from time to time.

Sceptics, however, have been questioning the legal problem as an influential factor in the underpricing of IPO shares ever since this issue was mentioned in the first place. As discussed by Alexander (1993), the reason for ignoring the litigation risk is that the cost of underpricing is huge relative to the average costs of lawsuit settlements and the possibility of a lawsuit. Yet in the existing literature we have reviewed, scepticism is not a mainstream argument.

1.4.6 Theories and the practice

It seems that academic studies have been thorough regarding the underpricing issue. The empirical investigations focus on the stock return, the investors' subscription and the market liquidity, and the theoretical studies focus on the information asymmetry, investors' sentiment, shareholders' arrangements and so on. However, most relevant research neglects the stand of the participants in the IPO practice and their judgement of the academic theories.

Fortunately, Brau and Fawcett (2006) present a unique survey of the chief financial officers' (CFOs) opinions of the IPO related theories and provide a link between theories and practice. The survey focuses upon seven IPO-related issues: motivation for going public, time of offering, underwriter selection, underpricing signaling, the offering process and the decision to stay private. The sample of firms is unbiased in respect of the selection of firms. In the sample, there are listed firms that have com-

pleted IPO, firms that are on the way of IPO and some firms that remain private but are capable of going public.

The survey reveals some interesting features of IPO-related issues. First, the results illustrate that CFOs believe the most important motivation for going public is to create public shares for acquisitions, while the major theoretical explanations, such as lowering the financing cost and the pecking order of financing, are of relatively minor importance. Second, CFOs choose the time of going public by considering the market and the industry stock returns, while the strength of the IPO market is less influential to the decision. Third, CFOs choose underwriters based on their overall reputation, quality of their research department, and industrial expertise. Fourth, CFOs view the historical earnings as the most positive signal and the top investment banker as the second strongest positive signal. Fifth, CFOs prefer firm-commitment underwriting contracts to other contracts, such as a best effort contract. Last, most of the decisions to remain private are made to maintain the controlling position of the firm.

Further to the underpricing puzzle, the survey focuses on two issues: expectations and explanations. The result indicates that CFOs are well informed on underpricing, the expected underpricing level of CFOs being on average 10.0% and the actual mean underpricing level is 13.5%. Among the many explanations of underpricing, CFOs value the reason of compensating investors for taking the risk of the IPO as the most important one, which is consistent with Beatty and Ritter's (1986) theory.

Three other reasons valued highly by CFOs are favourable allocation to institutional investors, achieving a broader ownership structure and increasing after-market liquidity.

Chapter 2
Analysis into IPO Underpricing and Clustering

2.1 Introduction

IPO underpricing is a well documented fact in many empirical studies in financial markets all over the world. During the period from 1990 to 1998, more than $27 billion were left on the table in the U.S. by IPO underpricing (Loughran, Ritter, 2002). Although great effort has been made to verify the existence of IPO underpricing and other IPO-related puzzles, such as the long-term underperformance puzzle, it is surprising that there is relatively few work on the degrees of IPO underpricing and the reasons for the differences in the level of underpricing.

Meanwhile, clustering, another IPO related question, is less noticed. In a few existing works related to IPO clustering (Hoffmann-Burchardi, 2001, Yung et al., 2006, Alti, 2005), the underpricing of IPO shares is always claimed as the result of clustering, regarding the information externality or investor sentiment. Yet the relationship between clustering and the level of underpricing has not yet been carefully examined in empirical studies.

In this chapter, we aim to explore the determinants to the underpricing level and the relationship between the level of IPO underpricing and the clustering. We start by reviewing the relevant literature.

2.1.1 IPO underpricing

The asymmetric information story is a natural first thought that an investigator would have when it comes to explaining IPO-related phenomena. As the Akerlof's "Lemon market", in a market for newly offered shares the public investors may know little about the firm and its shares. The IPO firms may face a consistently pessimistic public that on average tend to undervalue the shares. Through the offering, better informed investors may take advantage of these pessimistic public by trading the IPO shares. At the end, their inside information becomes public, appearing in the trading price of the shares in secondary market.

The other interpretation of the information asymmetric theory is the avoidance of the "winner's curse" (Rock, 1986). Usually, the best informed investors are not the successful bidders. The best informed investors do not want to bid for shares because the fair price according to their information is lower than the trading price. As a result, the successful but uninformed bidders are cursed in the offering, paying an extra amount of money for some the shares that are less valuable. The consequence of the "winner's curse" is that the uninformed investors will only win when the shares are not so valuable.

Since the IPO firms are young on average and with relatively opaque information, irrational investor story claims that the irrational investors might misperceive the value of the information about the shares and the market momentum to invest. Ljungqvist, Nanda and Singh (2004) first model the sentiment investors in IPO market. Intuitively, those sentimental or irrational investors should die out in the financial markets and in the long run only rational investors could survive. However, existing research (Yan, 2005) presents evidences that in a limited arbitrage world, the irrational investors might be able to survive long enough to drive prices to an "unreasonable" level for a considerable period (bubbles).

The agreement theory is based on the assumption that the issuer wants some target investors. The underpricing is purposeful as it serves to attract more investors and select the most desirable one. The intentions could be either to attract investors who can aid in acquisitions that are being financed by the IPO (Brennan and Franks, 1997), or to attract investors who are more likely to be favourably disposed to the firm's business or methods of management (Stoughton and Zechner, 1997). In both cases, the target investor selection will increase the value of the firm. Unlike the information asymmetry and sentimental theories, this kind of underpricing theories is because of artificial arrangements and the degree of underpricing is controlled by the issuers.

There are many other interpretations for the IPO puzzles, such as legal problems, price stabilisation strategy, and tax issues. However, none of them alone could

explain the underpricing puzzle. Moreover, most of theoretical works which aim to shed light to IPO's underpricing assume that the IPOs are independent in time so that the level of underpricing should not show any pattern in time series. As we will see it is not the case and the level of underpricing exhibits strong auto-correlation. After all, the question is still remaining: Why are IPO shares underpriced?

2.1.2 IPO clustering

Traditionally the reason for IPO clustering has been always related with the industry specific information or investor sentiment. Mauer and Senbet (1992) argue that the price exhibited in secondary market of an IPO firms can reduce the uncertainty of the following firms going public. Booth and Chua (1996) argue that the marginal cost of information can be reduced for firms going public at the same time.

Along the line of the information spillover, Hoffmann-Burchardi (2001) focuses on the revelation of a common-value component in the process of price determination, and lays emphasis on the importance of information externalities. The price of the IPO shares of one firm from a particular industry serves as an indicator of the common positive information about the followers in the same industry.

From the entrepreneurs' perspective, Hoffmann-Burchardi claims that a firm with utility-maximising risk-averse characteristic will go public if and only if the entrepreneur gains less from the risky cash flow from the firm than selling it to the public risk-neutral investors. In his model where firms go public sequentially, one

after another, the value of the firm is decided by two factors: firm specific factor and industry specific factor. There is asymmetric information between the entrepreneurs and investors. The entrepreneur does not know much about industry specific factors, while he may be better informed about the firm specific factor. On the other side the investors in the market may posses more information about the industry specific factor than the issuer. Once the issuer believes the market value is much greater than he estimates, which indicate the market is hot, he will sell shares to the market. They conclude that this story also explains why hot market often coincides with greater underpricing. In the market where trading price is greater than that expected by issuer the underpricing is more severe for sure.

Meanwhile, some researches show that time-varying adverse selection, the result of information asymmetry, plays a more important role in IPO clustering. Benninga, Helmantel, and Sarig (2005) argue that IPO clustering in a particular industry is triggered by the firm with the highest cash flow in this industry going public, which in turn produces the information of both the firm's value and the investment opportunities in this industry. The valuable information about the industry prospect being perceived by both investors and private firms serves now as a focal point for another agents and leads to clustering. The cluster dies out with the end of market optimism. Additionally, Jain and Kini (2005) believe that lower information asymmetry between issuers and investors together with an increase in investor optimism are also important factors to trigger the IPO cluster. Meanwhile, they claim that the downside

of the IPO clustering is because of the over-investment in one industry, which results in a long term under performance.

Up to my knowledge, the closest research to the research in this chapter is the one made by Lowry and Schwert (2002). They directly test the relation between clustering and underpricing level. By examining the sample of IPOs during the period from 1960 to 1997, they find that the IPO volume and average underpricing are highly auto-correlated, and that the greater number companies tend to go public after periods of high IPO underpricing. They conclude that similar types of firms choose going public at the same time. More importantly, the offering registration information has an effect on the offering price and going public decisions. In their analysis they use the average underpricing data for each month instead of the underpricing level of each IPO share as we do. Also they do not differentiate between different industry sectors except for high tech firms which are insufficient to justify any arguments related to the industry specific factor. Their conclusion that "similar" firms choose the same time of being public seems to be a premature one. Furthermore, failing to control the influence of initial selling volume on the initial return leaves us with another unanswered question: Is the cluster just a gathering of firms or an increase demand for capital?

2.1.3 Structure of the chapter

In this chapter, we test the hypothesis using data sample from the Hong Kong equity market. On one hand, overwhelming research has been done in mature financial market, such as United States and United Kingdom. However, the Hong Kong market is seldom mentioned in the existing literature. It is reasonable to believe that by using the data from Hong Kong market, the research could provide new data to extend the existing research. On the other hand, it is arguably that the rules for financial market are incomplete and changing over time. Applying the data sample from emerging market, such as India and Mainland China, the research may be less convincing when we compare the result with the existing literature.

In this chapter, we examine the empirical data to answer the above posed questions. Also, it simulates a shock on the underpricing to demonstrate the relationship between liquidity and underpricing level. The simulation result suggests that the competition among IPO shares and the effect of liquidity shock is determined by some exogenous parameters, but not by the shocks *per se*. Furthermore, this research focuses on the liquidity shock, and also demonstrates that the clustering is neither the reason for nor the result of the severe underpricing. The reasons for the clustering may vary, and further investigation is needed but beyond this research.

The research is organised as follows. In Section 2.2 we describe the data set. Section 2.3 shows the result of the empirical analysis. In section 2.4 we discusses

results and simulates a shock to demonstrate their robustness. We propose a type of option to hedge the liquidity risk in Section 2.5 and then conclude in Section 2.6.

2.2 Data

The data used in this chapter is from Investment Service Centre of the Hong Kong Exchange and Clearing Limited for initial public offerings from the November, 1999 to the end of 2005. The offer price, number of shares offered and the date of the first trading day of the IPO shares are collected from their prospectus in Hong Kong Exchange's public document database. First day open price and trading volume are collected from both Datastream Advanced(DA) and Yahoo! Finance [16], since some trading prices are missing from either DA or Yahoo! database. A few trading information are still missing from both of them. The information about the industry sector categorisation is also collected from Datastream Advanced. Except for internet bubble, none other significant bubble was recorded in Hong Kong market and worldwide as well during this period. Internet bubble is significantly influential in U.S. financial market, but much more moderate in Hong Kong. By considering other industries were not significantly influenced by the internet bubble and the availability of the data, the data from year of 1999, 2000 and 2001 is included.

The IPO prospectus before November 1999 is not available on the Hong Kong exchange web page. The IPOs after 2005 are not included in this research because

[16] Yahoo! Finance, Hong Kong, http://hk.finance.yahoo.com.

of blooming of IPOs in both China Mainland and Hong Kong since the beginning of 2006.

The interest rate is used as the risk free rate in this research. The information of interest rate are separately collected from The People's Bank of China (PBC), China's central bank, for one year fixed rate for Yuan (RMB) and Hong Kong Census and Statistic Department for Hong Kong dollar's "best lending rate". Here we do not take the exchange rates as a risk factor, since the exchange rate is almost fixed for both currencies. RMB kept its exchange rate to US dollar at the level of 8.27 during the period and Hong Kong dollar was kept at the level between 7.758 and 7.799.

The underpricing level (UP_i) is defined as the ratio of the difference between first day open price ($OPEN_i$) and offering price ($OFFER_i$). The market initial selling (CAP_i) is defined as the product between the shares offered (N_SHARE_i) and the open price ($OPEN_i$).

$$UP_i = \frac{OPEN_i - OFFER_i}{OFFER_i} \tag{2.1}$$

$$CAP_i = N\_SHARE_i \times OPEN_i \tag{2.2}$$

In this research we use log market capitalisation based on e (LN_CAP_i) to represent market capitalisation. The number of IPOs (N_t), total initial selling volume ($LN(CAP_t)$) in every month are used to describe the trend of the IPO market. There

Panel A: Basic Information					
	Min	Max	Mean	Std Dev	N
UP	-0.96	21.00	0.35	1.94	454
LN(CAP)	12.90	24.85	18.84	1.70	455
OFFER	0.10	84.00	1.78	4.46	490
VLM	14378	3637142272	109492411.9	251435461.2	455
N_SHARE	4002005	26485944000	423497776.4	1761543296	490

Panel B: Number of IPOs			
Time Window	Total No. of IPOs	Avg No. of IPOs per Month	Std Var of No. of IPOs per Month
1999 Nov to 1999 End	15	7.00	0.50
Year 2000	85	7.08	13.36
Year 2001	88	7.33	17.88
Year 2002	108	9.00	13.45
Year 2003	64	5.33	8.97
Year 2004	66	5.50	12.09
Year 2005	64	5.33	20.79

Table 2.1: Descriptive statistics for the IPO sample

are 34 industry sectors($INDSECT_i$) with 440 firms in total, plus "unclassified sector" which consists of 50 firms.

Table 2.1 provides the descriptive information about the variables used in this research. In the sample period, the average underpricing level is 34.9%. In only one extreme case with stock code 8036, "36.com Holding Limited", the underpricing is 399.0, which is excluded from the descriptive statistics. Some of the data are not available, so the number of data is not the same for different variables as it is shown in Table 2.1.

The statistic information about the underpricing level and capitalisation in different industries are listed in Table 2.2. By the sector information provided in Datas-

tream, the IPO firms are distributed among 34 industries. The "Unclassified cases" refers to the firms without sector information in Datastream.

Among all classified industries, the mean of underpricing level for a particular industry is minimal for the industry labeled by "Oil and Gas Producers" and maximal for "Travel & Leisure". The greatest averaged underpricing level is in unclassified group. Only one firm is in the "Mobile Telecommunications" industry and it has the greatest average market capitalisation, while the "Chemicals" industry has the lowest average capitalisation. "Personal Goods" is the largest industry group in our sample, except the "Unclassified Cases" group. The numbers of samples vary across different industries.

2.3 Empirical Findings

2.3.1 Underpricing auto-correlation and capitalisation impact

Since the trading price is immediately effective in the secondary market, the issuer will always suffer a loss from selling its shares at price lower than the market price with the discount rate equal to the underpricing level. Thus the underpricing level is also regarded as the measure for the cost of capital for the issuers. If the issuer hopes to sell their shares successfully, the underpricing level must be competitive. Examining the aggregated underpricing data series by unit root assumption (Phillips-Perron test), I find that the stochastic trend exists in the time series of data and this

Industry Sectors	UP				CAP(million HKD)				N
	Min	Max	Mean	StdDev	Min	Max	Mean	Std Dev	Valid Cases
Electronic, Electrical Equip.	−0. 55	0. 98	0. 03	0. 30	146. 42	1, 456. 00	228. 00	361. 25	17
General Retailers	−0. 79	0. 28	−0. 07	0. 37	12. 80	1, 920. 96	456. 75	702. 81	9
Leisure Goods	−0. 03	0. 26	0. 05	0. 09	7. 35	1, 320. 00	397. 97	509. 57	7
Household Goods	−0. 66	4. 71	0. 33	1. 20	27. 00	1, 952. 70	236. 96	491. 38	16
Mobile Telecommunications	0. 10	0. 10	0. 10	N.A.	43, 895. 41	43, 895. 41	43, 895. 41	N.A.	1
Software & Computer Services	−0. 90	19. 59	1. 04	3. 48	4. 48	5, 100. 00	394. 28	905. 03	34
General Industrials	−0. 20	0. 04	−0. 02	0. 11	51. 00	196. 00	103. 33	64. 89	4
Personal Goods	−0. 07	0. 32	0. 06	0. 08	21. 06	2, 272. 91	235. 30	418. 93	37
Technology Hardware & Equip.	−0. 10	4. 81	0. 24	0. 85	27. 97	12, 466. 67	720. 79	2, 241. 45	24
General Financial	−0. 71	0. 90	0. 09	0. 38	20. 30	315. 00	85. 66	80. 42	11
Real Estate	−0. 12	0. 55	0. 13	0. 23	0. 00	3, 820. 28	845. 78	1, 340. 05	7
Travel & Leisure	−0. 04	9. 65	2. 47	3. 82	51. 50	18, 400. 00	4, 655. 07	7, 573. 99	6
Industrial Metals	−0. 20	0. 27	0. 00	0. 20	44. 00	3, 928. 94	1, 666. 49	1, 861. 13	4
Pharmaceuticals, Biotechnology	−0. 02	1. 14	0. 22	0. 33	0. 00	2, 875. 40	285. 68	657. 71	15
Construction & Materials	−0. 69	0. 42	0. 02	0. 22	15. 50	600. 60	135. 92	178. 72	14
Industrial Transportation	−0. 09	0. 10	0. 01	0. 05	22. 00	7, 671. 40	1, 947. 08	2, 428. 96	10
Oil Equipment & Services	0. 04	0. 88	0. 27	0. 35	57. 60	2, 402. 37	578. 45	1, 020. 66	4
Food & Drug Retailers	0. 05	0. 08	0. 06	0. 02	65. 75	607. 50	290. 52	282. 40	3
Support Services	−0. 05	3. 26	0. 32	0. 89	39. 37	5, 120. 00	501. 92	1, 390. 44	11
Healthcare Equipment, Services	0. 02	1. 00	0. 33	0. 41	74. 88	209. 30	125. 93	52. 16	5
Industrial Engineering	0. 00	0. 65	0. 12	0. 20	50. 40	5, 083. 68	765. 42	1, 440. 85	13
Automobiles & Parts	0. 00	0. 37	0. 12	0. 14	41. 86	4, 047. 70	1, 020. 93	1, 418. 04	8
Banks	0. 00	0. 12	0. 03	0. 05	2, 302. 30	62, 241. 97	21, 992. 48	24, 660. 02	5
Media	−0. 08	0. 51	0. 11	0. 14	13. 67	4, 500. 00	376. 59	887. 97	22
Chemicals	−0. 94	9. 00	1. 08	3. 52	3. 00	103. 54	46. 50	33. 15	5
Food Producers	−0. 14	0. 41	0. 10	0. 13	52. 20	1, 685. 17	467. 64	547. 18	13
Equity Investment Instruments	−0. 96	0. 52	−0. 17	0. 45	0. 40	326. 35	73. 91	105. 36	11
Mining	0. 01	0. 42	0. 22	0. 30	163. 70	23, 129. 42	11, 646. 56	16, 239. 22	2
Forestry & Paper	0. 27	0. 27	0. 27	N. A.	151. 20	151. 20	151. 20	N. A.	1
Beverages	−0. 78	0. 30	−0. 19	0. 54	31. 54	876. 00	378. 90	441. 69	3
Nonlife Insurance	0. 34	0. 40	0. 37	0. 04	594. 42	7, 272. 58	3, 933. 50	4, 722. 18	2
Life Insurance	0. 02	0. 27	0. 14	0. 18	14, 572. 87	29, 441. 18	22, 007. 02	10, 513. 48	2
Fixed Line Telecommunications	−0. 01	0. 13	0. 06	0. 06	23. 26	10, 503. 40	4, 160. 63	5, 490. 69	4
Electricity	0. 07	0. 14	0. 10	0. 05	2, 760. 00	2, 851. 20	2, 805. 60	64. 49	2
Oil & Gas Producers	−0. 65	0. 06	−0. 19	0. 40	10, 864. 65	28, 191. 22	20, 520. 45	8, 832. 20	2
Unclassified Cases	−0. 79	399. 00	6. 30	47. 39	12. 10	40, 320. 00	889. 26	4, 802. 35	59

Table 2.2: Statistical information of IPOs across industry sectors

trend should be removed from the underpricing series. Instead of the variable UP_i, this research uses the difference in two nearest underpricing level ($diff(UP)_i$) as the dependent variable. The same unit root test has been performed on this data set and no significant trend is found. Moreover, the initial selling (CAP_i) of the IPO *per se* will also influence the underpricing level when the liquidity in the market is limited. First we perform the regression test on the following equation.

$$diff_i = \sum_{j=1}^{J} k_j diff_{i-j} + k_0 \ln(CAP_i) + pi_{hk} + c + \varepsilon_i. \tag{2.3}$$

The test results for various choices of J are shown in Panel A of Table 2.3. The results suggest that when $J = 7$ the regression becomes significant. At that time the CAP_i significantly influences the difference in the underpricing level. The dummy variables $Y99$, $Y00$, $Y01$, $Y02$, $Y03$, $Y04$, and $Y05$ are used to represent the market wide factors in different years. For example, if the IPO takes place in the year 1999, $Y99$ is 1. Otherwise, the variable $Y99$ equals to 0. As shown in Table 2.3, none of the year dummy variable is significantly influential to the regression. The insignificant result suggests that during the sample period, there is no temporary shock in the financial market.

It is interesting that the initial selling positively influences the difference of underpricing level, but not the underpricing itself (the last is confirmed by performing corresponding test). Supposing that the capitalisation is constant and equal to its average level, we could expect that $diff_i$ will be zero. So the average underpricing

in period i will remain the same as the previous one. This result suggests that if the selling of IPO shares is continuous without huge jumps the underpricing will remain at the same level. The R square in this testing is 0.44 in this regression, suggesting the liquidity shock caused by the initial selling and the auto-regression part explain considerable part of the change of underpricing. Other factors, such as risk free rates (the Hong Kong interest rate i_{hk} and the Mainland China interest rate i_{cn}, are not significant in this regression.

Time should be another factor in measuring market liquidity. Define as the time distance between IPO i and i-1. Another regression test is done on the following equation:

$$diff_i = \sum_{j=1}^{J} k_j diff_{i-j} e^{-t_{i-j}} + k_0 \ln(CAP_i) + c + \varepsilon_i \tag{2.4}$$

Yet the regression is not significant, and cannot rule out the hypothesis that all k_j are statistically zero. This result suggests that the liquidity shock does not exist on time scale, but on the scale of sequential IPOs. This result is interesting. If the large scale initial selling is regarded as the liquidity shock on the market, issues of liquidity should rather be considered on the scale of IPOs' sequences than on the natural calendar time scale. The additional argument could be that investors prefer IPOs shares over common ones which are available at any point of time.

Insignificant influence of interest rate and none existence of time factor in underpricing auto-regression together imply that the liquidity here is not the usual market liquidity, but rather the capital liquidity for IPO shares.

Traditionally industry cycles and industry specific risk have been used to explain the underpricing and clustering. A similar analysis has been performed within different industry sectors to verify the influence of liquidity shocks. The result of this testing is shown in Panel B of Table 2.3. Since the analysis is limited by the number of samples available in different industry sectors, only four industry sectors with significant number of firms are available for performing such regression: "Electronic, Electronic Equip.", "Software & Computer Services", "Personal Goods" and "Media".

No significant relationship is shown among $\ln(CAP_i)$ and $diff_i$ variables in any of these sectors as we found earlier. This again verifies the finding that the change in underpricing is not caused by the business cycles in different industries, change of risk factors, or investors' optimistic or pessimistic views about different industries, but due to the liquidity shocks. Basically, the IPO shares are chasing the capital by changing the underpricing level, regardless of their industry sectors.

Based on the negative coefficients in the auto regression, I found that the underpricing level trends to be stable except when great liquidity shock comes. Since the calendar time is not involved in this regression, the result does not imply that the

Panel A: Aggregate Data

Dependent Variable: UI_t

	1	2	3	4	5	6	7	8	9 [a]
Const	-51.675 **	-51.760 **	-52.304 **	-53.179 **	-51.800 **	-52.245 **	-53.101 **	-54.652 **	-51.620 **
	(15.288)	(15.282)	(15.408)	(15.602)	(15.323)	(15.364)	(15.435)	(15.810)	(15.252)
Δf_{t-1}	-0.852 **	-0.852 **	-0.852 **	-0.852 **	-0.852 **	-0.85 **	-0.852 **	-0.853 **	-0.852 **
	(0.057)	(0.057)	(0.057)	(0.057)	(0.057)	(0.057)	(0.057)	(0.057)	(0.056)
Δf_{t-2}	-0.733 **	-0.733 **	-0.733 **	-0.733 **	-0.733 **	-0.73 **	-0.73 **	-0.734 **	-0.733 **
	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)	(0.073)	(0.072)
Δf_{t-3}	-0.613 **	-0.613 **	-0.614 **	-0.614 **	-0.613 **	-0.61 **	-0.61 **	-0.615 **	-0.613 **
	(0.080)	(0.080)	(0.080)	(0.080)	(0.080)	(0.080)	(0.080)	(0.081)	(0.080)
Δf_{t-4}	-0.495 **	-0.495 **	-0.496 **	-0.496 **	-0.495 **	-0.50 **	-0.50 **	-0.497 **	-0.495 **
	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.084)	(0.083)
Δf_{t-5}	-0.381 **	-0.381 **	-0.381 **	-0.381 **	-0.381 **	-0.38 **	-0.38 **	-0.382 **	-0.381 **
	(0.081)	(0.081)	(0.081)	(0.081)	(0.081)	(0.081)	(0.081)	(0.081)	(0.080)
Δf_{t-6}	-0.256 **	-0.256 **	-0.256 **	-0.256 **	-0.256 **	-0.26 **	-0.26 **	-0.257 **	-0.256 **
	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)	(0.073)	(0.072)
Δf_{t-7}	-0.135 *	-0.135 *	-0.135 *	-0.135 *	-0.135 *	-0.14 *	-0.14 *	-0.136 *	-0.135 *
	(0.056)	(0.056)	(0.056)	(0.056)	(0.056)	(0.056)	(0.056)	(0.057)	(0.056)
$Ln(CAP)_t$	2.761 **	2.779 **	2.786 **	2.820 **	2.765 **	2.800 **	2.85 **	2.981 **	2.760 **
	(0.814)	(0.817)	(0.817)	(0.823)	(0.814)	(0.821)	(0.825)	(0.852)	(0.812)
Y99	1.096							0.087	
	(13.947)							(14.200)	
Y00		-0.870						-1.788	
		(3.070)						(3.698)	
Y01			1.301					0.078	
			(3.891)					(4.417)	
Y02				1.474					b
				(3.040)					
Y03					0.588			-0.556	
					(4.075)			(4.601)	

Table III continues

Y04						-1.907		-3.009	
						(5.152)		(5.648)	
Y05							-3.417	-4.405	
							(5.283)	(5.781)	
R Square	0.435	0.435	0.435	0.435	0.435	0.435	0.435	0.436	0.435

Panel B: Autoregression within industries

Industry	Electronic, Electrical Equip.		Software & Computer Services		Personal Goods		Media	
	Coef	StdError	Coef	StdError	Coef	StdError	Coef	StdError
Const	0.06	0.12	-38.15 **	10.45	-0.06	0.32	-1.81	0.79
Δf_{t-1}	-1.11	0.57	-0.89 **	0.17	-0.74 **	0.22	-1.23	0.31
Δf_{t-2}	-0.48	0.72	-0.70 **	0.22	-0.74 **	0.28	-1.16	0.35
Δf_{t-3}	-0.11	0.57	-0.56 *	0.24	-0.72 **	0.29	-0.27	0.66
Δf_{t-4}	-0.22	0.29	-0.40	0.23	-0.63 *	0.30	-0.65	0.29
Δf_{t-5}	-0.22	0.21	-0.23	0.22	-0.64 *	0.30	-0.47	0.24
Δf_{t-6}	-0.15	0.15	-0.28	0.20	-0.12	0.29	-0.74	0.27
Δf_{t-7}	-0.02	0.12	-0.07	0.15	-0.09	0.24	-0.55	0.29
$Ln(CAP)_t$	0.00	0.01	2.07 **	0.57	0.00	0.02	0.10	0.04
R Square	0.75		0.44		0.49			0.97

** Significant at 5% level

* Significant at 10% level

[a] The model 1,2,3,4,5, 6 and 7 uses dummy variable of year Y99, Y00, Y01, Y02, Y03, Y04 and Y05 respectively. Model 8 uses the whole group of dummy variables, while model 9 uses none.

[b] Variable Y02 is excluded because the dummy variable matrix is near singular matrix.

Table 2.3: Underpricing autocorrelation test and the capitalisation impact.

	Coef		Std Error
$\Delta(cap)_{-1}$	-0.66	**	0.06
$\Delta(cap)_{-2}$	-0.57	**	0.08
$\Delta(cap)_{-3}$	-0.49	**	0.09
$\Delta(cap)_{-4}$	-0.29	**	0.06
$\Delta(cap)_{-5}$	-0.16	**	0.06
R Square			0.27

** Significant at 1% level

Table 2.4: Autoregression of IPO capitalisation

underpricing will be clustering in time. But the clustering will happen when the IPOs come more frequently with greater initial selling.

2.3.2 Clustering of capitalisation, number of IPOs

Since the severe underpricing level is caused by liquidity shock, the initial selling waves (peaks) are crucial to understand the changes in underpricing.

The clustering can be discovered in the frequencies of IPOs and the average initial selling in a longer period. With time window of one month, the number of IPOs (N_t) is used to represent the frequency and total initial selling ($TCAP_t$) of each month and thus get the average initial selling of IPO shares ($ACAP_t$). The number of IPOs in every month is illustrated in Figure 2.1, and the average initial selling in every month is presented in Figure 2.2.

The autoregression results show that only previous 5 periods have significantly influence on the initial selling now, whereas the autoregression result of underpricing

shows that previous 7 periods matters. This difference in time series indicates that the underpricing have different cycles from initial selling.

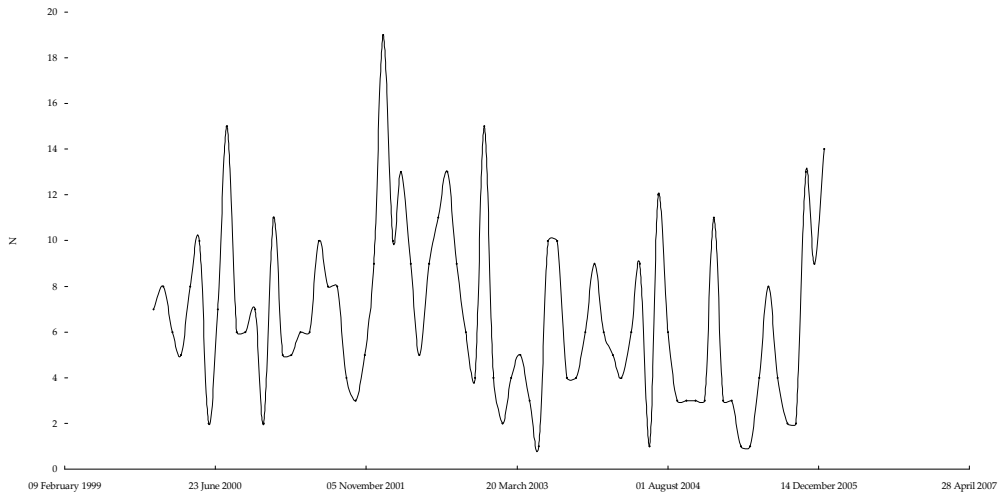

Figure 2.1: Number of IPOs over time in Hong Kong market from November 1999 to December 2005

A Spearman correlation test among frequencies, average underpricing and aggregated initial selling is crucial to find out the relation between clustering and underpricing. The result of the correlation test is shown in Table 2.5. This result shows that the clustering measured by the number of IPOs, N, is not correlated with the average underpricing level, AUP. The average initial selling of IPO shares of every month, $LnACAP$, is not correlated with average underpricing of that month, either.

This evidence is contrary to the predictions of many theoretical papers which claim the severe underpricing is either the result of a bubble, or the reason of a bubble.

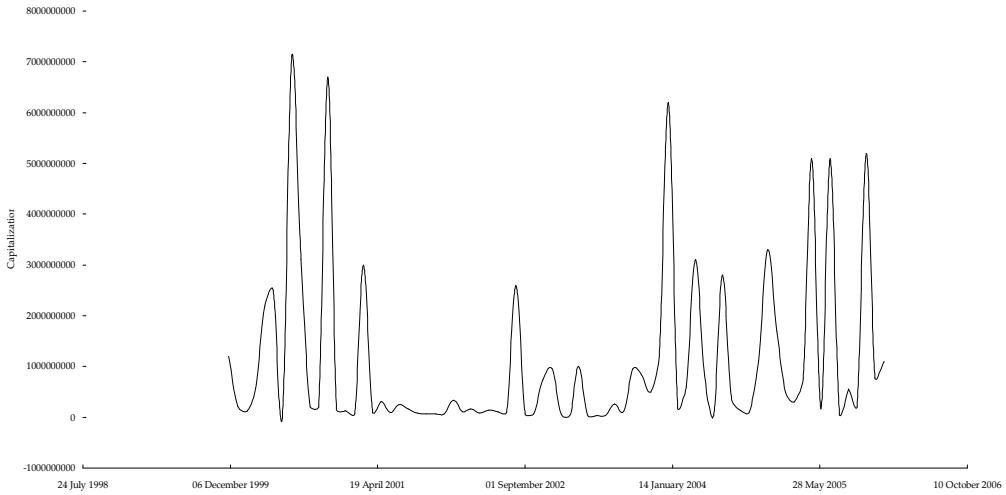

Figure 2.2: Average IPO capitalisation in Hong Kong market from November 1999 to December 2005 (monthly).

		N	ln(ACAP)	AUP
N	Spearman's rho	1.000	-0.991**	0.249
	Sig. (2-tailed)		0.000	0.306
	N	74	74	74
ln(ACAP)	Spearman's rho	-0.991**	1.000	-0.208
	Sig. (2-tailed)	0.000		0.075
	N	74	74	74
AUP	Spearman's rho	0.249	-0.208	1.000
	Sig. (2-tailed)	0.306	0.075	
	N	74	74	74

**Correlation is significant at the 0.01 level (2-tailed).

Table 2.5: Correlation test on the relationship between clustering and underpricing level.

In some cases, more severe underpricing is observed in the period of IPO clustering and seemingly they are related. Especially in 1999, during the "dot-com bubble", the average underpricing was 69%. However, the relationship between these two variables is not statistically significant in our sample. And thus it is reasonable to believe that a severe underpricing is not a necessary consequence of clustering.

2.3.3 Remarks

Based on the regression result of underpricing, I simulate the time series process by injecting a shock of initial selling volume, which is much greater than normal initial selling volume. The result is shown in Figure 2.3. The following equations are used for this simulation:

$$up_i = up_{i-1} + diff_i \tag{2.5}$$

$$diff_i = \sum_{j=1}^{7} k_j diff_{i-j} + \varepsilon_i \tag{2.6}$$

Here we use the value of k_j in Panel A (Table 2.3) and injected one liquidity shock of the size -10[17] at the step $i = 500$. There are in total 1000 steps (periods) in the simulation, and we take $\varepsilon_i = N(0, 1)$. To keep things simple, here we initialise the first 7 period up_i by the the first 7 realisations of ε_i and eliminate the constant in

[17] The particular size of the shock does not change essentially transition path represented in Figure 2.4.

the first order difference equation (2.3), by assuming that the majority of IPO initial selling are at the average level.

The dotted line in Figure 2.3 is the simulated underpricing level without shock, and the continuous line is with shock. The enlarged shock effect can be seen in Figure 2.4. The first impression is that the shock causes volatility of underpricing level to increase, and also moves the underpricing out of its equilibrium level.

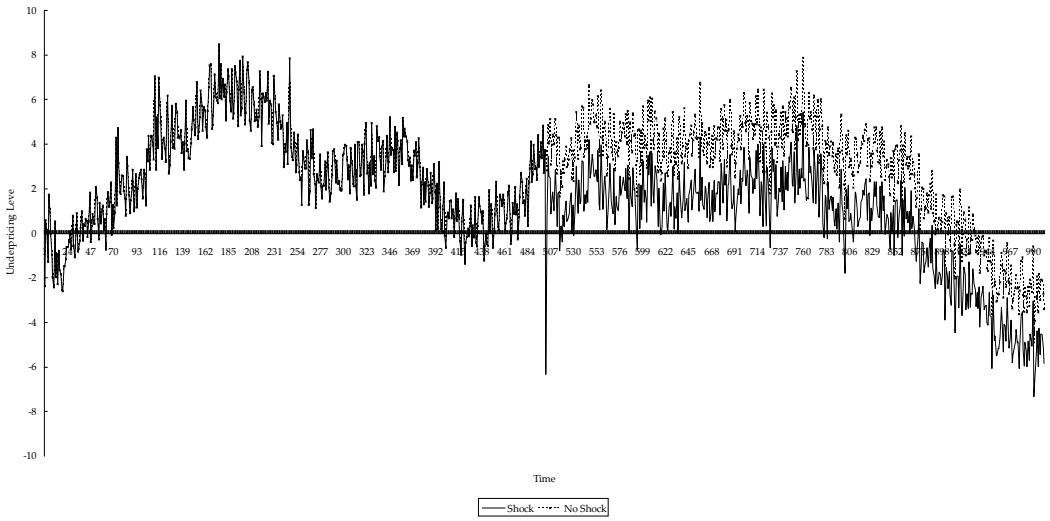

Figure 2.3: Simulation of shocks in IPO underpricing.

It is noteworthy that the volatility effect of the shock in this simulation will be lasting for 21 periods after the shock until the volatility reduced to less than 1% of the shock, and the length of the period is solely decided by the k_j, neither change after the variance of ε_i, nor the size of the shock. The percentage of change as the consequence of the shock remains the same when the variance of ε_i is changed to

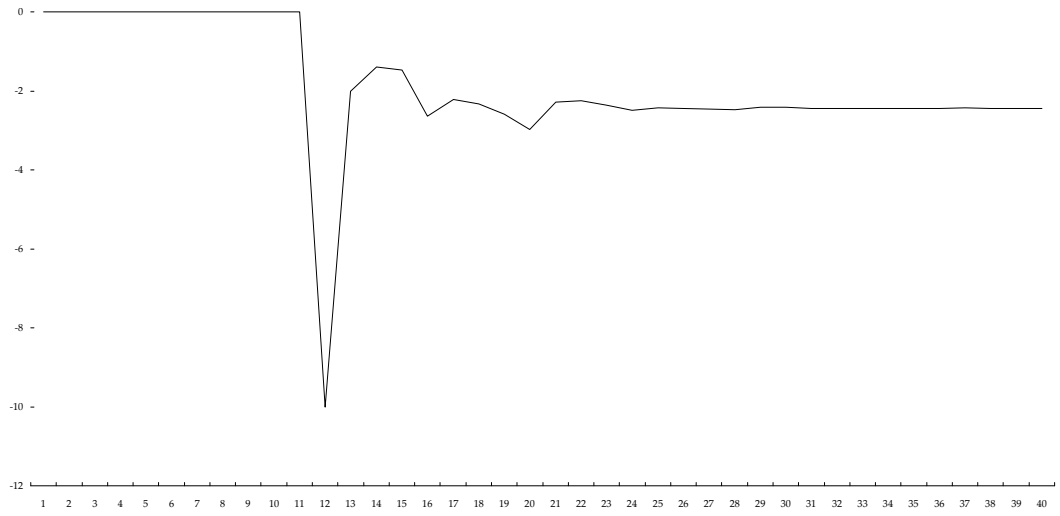

Figure 2.4: Shock effect over time in IPO underpricing level.

100, or the shock is changed to 1 and 600. The underpricing level changed by the shock related with the size of the shock, but the ratio of the changed level over the size of the shock depends solely on k_j.

The k_j and constant in the regression should be varying and intrinsic in different market. Ritter[18] records average initial returns (underpricing level) in 39 countries and areas. Figure 2.5 shows the 5 countries with highest average initial return and 5 countries with lowest average initial return. Although the time period varies in the average initial return date in different countries, the difference between the two groups is clearly shown. The average underpricing level in the 5 lowest countries are 8.40%, while 121.84% in the 5 highest countries. Those countries with highest

[18] Jay Ritter, IPO Data, http://bear.cba.ufl.edu/ritter/ipodata.htm, 2007.

underpricing level are usually those with immature financial market and strict capital control. This implies that there is limited capital liquidity and the investors have limited ability to arbitrage because of capital control in the emerging markets.

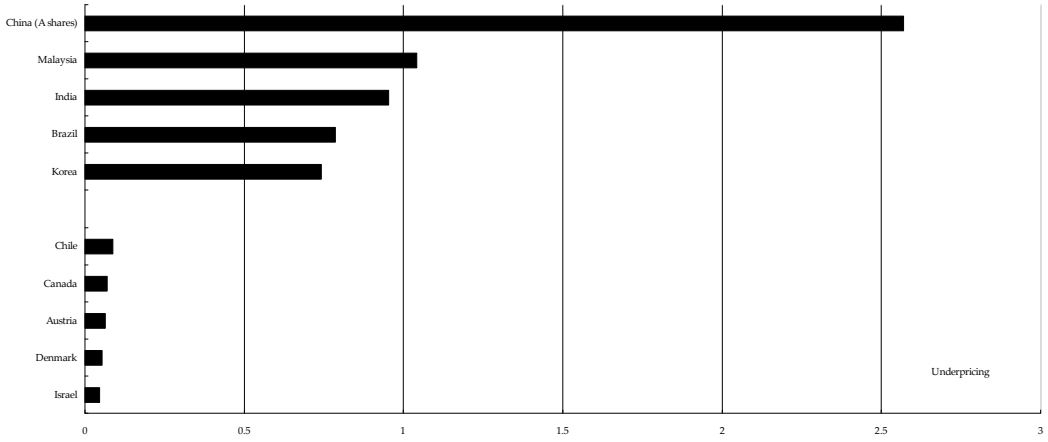

Figure 2.5: The average underpricing level across countries.

2.4 IPO Option

2.4.1 Option design

The main finding of this research is that the IPO underpricing level is subject to the market liquidity, in other words, the extend of the distress of the funding. In practice, the investment banks are trying to predict the level of the market liquidity, time series properties of the underpricing level is cyclical. Since the investment banks in mature

market have better knowledge of the market and can predict the market liquidity more accurately, the average underpricing in different countries varies. However, since the prediction of the market reacts could not be accurate, the issuer, underwriter and primary market investors are still exposed to the liquidity risk in the offering process. An option linking IPO shares in first trading day in secondary market is needed to offset the risk.

The option could be designed as follows. Assume that company Q is going public, and the offer price in primary market is P_1 while trading price in secondary market on the first day open is P_2. We can set the target of the IPO put options X at P_2 and allow the trading of the options before the trading of the shares in secondary market.

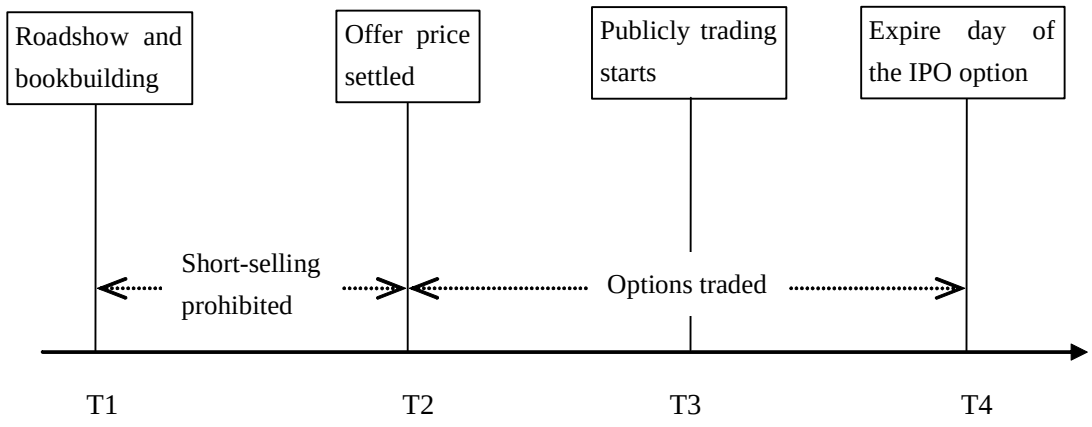

Figure 2.6: The design for the option of IPO shares.

This option arrangement will help in two ways. First, it will help investors to hedge their risk when buying the stocks in the primary market, while having relatively insufficient knowledge about the stock they hold. As a result, with the IPO put option X they can lock-up their profit by bearing this knowing-nothing risk. Second, the option arrangement will help issuer and underwriter to stabilise the price in the first few days in the secondary market and encourage investing in primary market. Consequently, the risk underlying in IPO shares in primary market will be largely reduced and the offer price in primary market could be at a reasonable higher level. Consequently, the underpricing level can be reduced.

For now, it seems to be a big problem for issuers and underwriters to stabilising the secondary market if they are not sure of that. Always they have to withdraw the IPO registrations after the first round investigation of the market condition when the market condition is not clear to them. Here is an example.

"Genutec Business Solutions Inc. filed with U.S. securities regulators to withdraw its registration statement for an initial public offering, citing market conditions. No securities of the company were sold in connection with the offering, Genutec said in a regulatory filing. The company had earlier filed for an IPO of up to $25 million of shares. "[19]

In fact, there are many IPO withdrawals in the business practice. According to the interview with Sam Snyder, senior analyst of IPOHome.com, by Associated

[19] Reuters, Aug 29th, 2007.

Press, as of Aug. 31, 2007, 25 companies have withdrawn their IPOs in the year and 27 companies as of this time in 2006. At the meantime, there have been 150 IPOs in 2007 and 105 IPOs in 2006. The withdraw ratio of IPOs is 16.6% and 25.7% in 2007 and 2006. With the IPO option, it's reasonable to believe that the withdraw ratio can be remarkably reduced.[20]

It is noteworthy that the underpricing will eventually turn into the cost of equity financing for the firm. If we think about the firms which can not afford the cost of going public, the reduction of this cost will therefore lead to more firm going public, and increase the efficiency of the market.

This arrangement also optimises the IPO mechanism. There is some argument about the mechanism of IPOs. In the old times, auction is the way underwriters selling IPO shares, while now in most of the cases bookbuilding method is the way of selling IPO shares. It reserves the advantage of auction method, which have a more accurate price and won't result in significant underpricing. Meanwhile, the basic form of the IPO selling is still bookbuilding system.

2.4.2 Alternative choices

Implementing IPO options in bookbuilding system is not the only way. Actually, there is some alternatives to function as the IPO options, such as the "when-issued" market in German market. Aussenegg, Pichler and Stomper (2003) investigate this market and discuss the advantage of the "when-issued" market and functions of the

[20] http://www.forbes.com/feeds/ap/2007/08/31/ap4073857.html

bookbuilding in the existence of the "when-issued" market. The "when-issued" market is the mechanism that investor can buy and sell securities in advance of the actual offering in a pre-auction. This kind of security marketing mechanism has been used in practise. In the U.S. Treasury Securities market, the investors can buy and sell securities and the pre-auction also reveals the market demand of the certain securities.

However, "when-issued" market is seldom seen in most of the IPO market in the world. In the U.S., for example, such trading activities are strictly prohibited by the U.S. Securities and Exchange Commission to prevent the covering of short sales. By Regulation M, Rule 105, the covering of short selling activities within the short period within the five business days before pricing or during the period beginning with the filing of the registration statement and ending with the pricing. And the reason for this is stated in "The Securities Exchange Act Release No. 38067 on Regulation M".[21]

Rule 105 is intended to prevent manipulative short selling prior to a public offering by short sellers who cover their short positions by purchasing securities in the offering, thus largely avoiding exposure to market risk. Such short sales could result in a lower offering price and reduce an issuer's proceeds."

In a detailed summary of this act by Goodwin Procter LLP[22] on December 13th, 2006, it is shown that the SEC began expressing their concern on short selling

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[21] SEC Rules, http://www.sec.gov/rules/final/34-38067.txt

[22] Goodwin Procter LLP, http://www.goodwinprocter.com/

before offering since 1972. In 1987, the SEC first proposed Rule 10b-21, and this was finally replaced by Rule 105 of Regulation M in 1996.

In this circumstance, the IPO option is left to be the only choice for hedging the risk of IPO shares. More importantly, the legal environment in many mature markets, such as the U.K. and Hong Kong, are almost the same as the U.S. This option is traded out of the prohibited period, since the trading period is between the end of pricing of the offering shares in bookbuiliding process and the start of trading in secondary market. Up till now, it is the very few financial products that can help to hedge the risk within a legal framework.

2.5 Concluding Discussion

This chapter investigates the IPO underpricing from the perspective of integrated primary and secondary market, and documents that the IPO underpricing is determined by the previous IPOs' underpricing level for the first time. It implies that there is a competition among IPO shares. Note that other outstanding stocks are excluded from this competition.

By analysing the distinctive feature of IPO cases in Hong Kong from November in 1999 to the end of 2005, this chapter documents the fact that apart from underpricing, there was significant clustering of IPOs over time. Moreover, the level of underpricing is closely related to the underpricing level of previous IPOs. This finding suggests that the underpricing is strategically arranged by underwriter's syndicate

to favour the investors. This investigation also reveals that the initial selling volume of IPOs is strongly auto-correlated. Together with IPOs' clustering, evidences also suggest that the issuers tend to choose the specific time to go public, and an increase in initial selling volume leads to more severe underpricing. It could be interpreted as the compensation for the liquidity shock caused by supplying a huge amount of shares in the market.

This underpricing competition implies the specific characteristic of IPO shares *per se*, which could be interpreted as a specific risk premium. This characteristic might also help us to understand the reason for IPO underpricing within the framework of rational investor paradigm in the future research.

The predictability of IPO underpricing by previous IPO underpricing clearly should not be the result of investors' sentiment, but rather a reflection of the risk, such as coordination problem in IPO and the compensation of the liquidity shock. The coordination risk comes from the asymmetric information, because IPO *per se* is a process of information creating, "information cascade" (Welch, 1992). The "information cascades" story claims that investors make their investment decisions sequentially. Successful initial sales encourage following investors to revise their own information about the share and to invest, and unsuccessful initial sales discourage the investors. IPO underpricing competition prevents public from continuous pessimism. Further investigations are needed to discover the nature of the risk associated with IPO shares within the framework of efficient market hypothesis (EMH).

This liquidity shock and IPOs' competition can also explain the severe underpricing during the internet bubble period around 1999. Documented by Ljungqvist and Wilhelm (2003), the IPO underpricing is 69% in the year of 1999 on average and 56% in 2000, whereas the underpricing in 1996 is only 17% on average. The initial selling of the IPOs is on average $65.3 million and $124.1 million in 1999 and 2000, significantly greater than the previous years. In 1996, 1997, 1998, the initial selling of IPO shares are $35.3 million, $32.6 million and $51.3 million. From the perspective of liquidity, this is exactly the result of the liquidity shock of IPO shares. Interestingly, the influence of previous IPOs underpricing level on the following one is not subject to the time interval between IPOs. In the regression, the underpricing level is not significantly related to the previous one when the time is added as a factor.

The investigation among different industries reveals that the IPO underpricing auto-correlation is not statistically significant at the industry level. Clearly the changes in IPO underpricing levels are not related with industry specific factors (specific risks), but the market factors (market risk), such as market liquidity. The analysis on the initial selling reveals that in the short run, initial selling volume is influenced by the previous IPO initial selling volumes. This fact indicates that despite the specific industry cycle, issue choose the time to go public mainly relying on information related to a few previous IPOs.

At the end of this research, we propose that an option of IPO shares can be helpful for the players in the IPO business in practice, regarding the reduction of liquidity risks in the offering. In addition, the option can also optimise the IPO mechanism within the bookbuilding framework.

The evidences presented in this chapter suggest that the IPO underpricing is predictable and the liquidity shocks caused by IPO shares at least partially explain the level of underpricing. Further promising investigation regarding the liquidity risks should focus on the specific risk factors associated with IPO shares.

Chapter 3
The Nature of Underwriter Network in IPOs: A Layered Structure

3.1 Introduction

It is a question worthy of note but rarely mentioned, that based upon which principles, a leading underwriter select the members for and construct the IPO syndicate. The fundamental question here is: why not undertake the underwriting business alone? In particular, when the commission fee for the underwriting service is proportional to the size of the IPO, it is innate that investment bankers should close the door to their competitors once the appointment of the leading underwriter has been made. Every time a new investment bank becomes involved in the one IPO, the cake of the underwriting business has to be split into more and smaller pieces. If this is true, the lead underwriter has no incentive to bring in other underwriters/members into the syndicate unless the latter can be helpful. Then, the question remains: what distinctive talent does the new member underwriter have such that the lead underwriter needs to pay for it?

Most of the relevant research focuses on the following areas. Having roots in behavioural finance theory, some researchers attempt to explain how underwriters manipulate their affiliated analysts' reports (McNichols and O'Brien, 1997; Irvine,

2003; Cliff and Denis, 2004) to influence investor's sentiment. Some other theories (Carter and Manaster, 1990; Rock, 1986) focus on the issue that the underwriters' reputation may possibly affect aspects of the IPO performance, such as the underpricing level and the aftermarket liquidity. Other theories explain how the underwriters use their networks and resources to win or secure their future underwriting appointments (Ljungqvist, Marston and Wilhelm, 2007). However, surprisingly little work has been done to answer the questions as to how the underwriter's syndicate is constructed, and why some underwriters recruit others but not all.

The primary aim of this chapter is to provide empirical evidence to identify the underlying mechanism in the construction of underwriter syndicates. It is intended to institute key indexes for syndicates and hence investigate their relationships with IPO performance. In exploring the nature of the underwriter network, using the cutting-edge methods of random network theory and simulation, this chapter shows that the underwriters de facto are connected with each other within two sub-groups. Normally underwriters do business with their peers who are in the same sub-groups. Empirical evidence suggests that the underwriting service that is provided by the two sub-groups of underwriters leads to different outcomes, and this finding has substantial practical implications for the investment banking business.

The following section reviews the literature. In Section 3.3, we describe the data. Section 3.4 presents the measures and the overview of the underwriting syndi-

cates. A comparison and analysis of the two sub-groups of underwriters are presented in Section 3.5 while Section 3.6 is the conclusion.

3.2 Literature Review

Normally syndicates rather than single underwriters serve IPOs nowadays in practice; yet the joint or syndicating form of the underwriting business has not always been in the dominant position. As documented by Ljungqvist et al. (2007), underwriting syndicates gained their dominant position around 1990 as the increase in issuers' capital demand exceeded the capability of individual underwriters. Within the syndicate, underwriters share the risk inherent in the process of fund-raising as well as sharing the revenue earned for providing underwriting services.

The first remarkable joint underwriting case was in 1906. At that time, as recorded by Carosso (1970), Goldman Sachs and Lehman Brothers began to build their long term exclusive comanagement relationship as underwriters for United Cigar Manufacturers and Sears, Roebuck & Co. In more recent decades, the lead underwriter has played a more important role than the other members of the syndicate, and takes a greater proportion of the underwriting fee as well, while co-underwriters in the early twentieth century took equal shares of responsibilities and fees.

3.2.1 Information gathering theory

Some claim the main reason for the syndicate is for the gathering of information. It is reasonable to believe that better knowledge of both the market's condition and investors' interest would help the syndicate to make better deals in IPO, in respect of the better price and a lower risk.

Among many proxies for the information set of an underwriter's syndicate, reputation is the most impressive one. Carter and Manaster (1990) first detect a relationship between the underwriter reputation and the initial public offering, based on the parallel theory of Rock (1986) which states that greater IPO underpricing is associated with greater participation of informed investors. In addition, they claim that underpricing is costly to the issuer.

Many papers continue to focus on the issue of underwriter reputation. Carter and Dark (1993) examine the relationship between the reputation of investment banks and the investors' subscription. They observe that flippers' performance in the IPO aftermarket varies with respect to two underwriter groups. In the class of underwriters with a lower reputation, flippers are more likely to dominate the offerings as the reputation increases. In the class with a higher reputation, however, the dominance of flippers declines as the reputation increases. In addition, Carter et al. (1998) discover that the reputation of underwriters is relevant to the long term performance of IPO shares.

It is important to mention that in both papers, the authors used the Carter-Manaster scale to measure the reputation of the underwriters. Under the Carter-Manaster scale system only the underwriter with the highest reputation counts for the reputation of the syndicate. Yet, the reason for choosing a single underwriter to represent the whole syndicate is somewhat ungrounded. As a result, any analysis based on this measurement may be potentially misleading.

Logue et al. (2002) document the relationship between underwriter reputation and market activities during the IPO process. They find that the underwriter reputation is significantly related to the pre-market underwriter activities, and weakly related to the aftermarket price stabilization. Contrary to the previous research, the relationship between the underwriters' reputation and issuer's returns was found not to be significant in this research.

3.2.2 Bookrunners' bargain theory

A strange and notable feature in the underwriting business is that the difference in the gross spreads (underwriting service fees) between single underwriter and syndicate underwriters is insignificant. In the U.S. market for a moderate sized IPO, for example, the underwriting fee is 7% of the size. This is convincing evidence that underwriters are not competing for the service fee.

Hu and Ritter (2007) assume that the bookrunners (lead underwriters) compete for business contracts using their advantage regarding analyst coverage and offer

prices, instead of competing using the underwriting fee. They find that reasons for larger underwriter syndicates are the increase in issue size, reduction in the influence of analyst coverage, and buyout backed IPOs. Consequently, the benefits for issuers of having multiple underwriters instead of a single one are greater bargaining power in capital market, high offer prices and a lower underpricing level. Further benefits for issuers may include building a tight relationship with commercial banks in the future. As their main concern was about managing underwriters, Hu and Ritter's research did not cover the role of the member underwriters of the syndicate.

3.3 Data

The data in this chapter comes from the Hong Kong Exchange and concern initial public offerings from November, 1999 to the end of 2005. The offer price, number of shares offered and the date of the first trading day of IPO shares are taken from the IPO prospectus in the public database of the Hong Kong Exchange. Since trading prices are sometimes missing from either source, the first day open trading price and trading volume data are collected from both Datastream and Yahoo! Finance (Hong Kong)[23]. The sector classification follows the information from Datastream.

This period was relatively quiet in respect to shocks. Except for the internet bubble, which was influential all over the world, no other significant bubble was recorded in the Hong Kong market and other world financial markets during this

[23] Yahoo! Finance (Hong Kong): hk.finance.yahoo.com

period. The internet bubble was much more moderate in the Hong Kong market than in the U.S. Considering that other sectors of industry were not significantly affected by the internet bubble, data from the internet bubble period, from 1999 to 2001, is as well included.

Data from after 2005 is excluded from our research because of the subsequent potential influence of the blooming of IPOs in the mainland China and the Hong Kong markets. Regulation of the state owned shares changed, in the "Nontradable Share Reform" launched by the China Securities Regulation Commission (CSRC), at the beginning of 2005 in mainland China, where the state owned shares played the determinant role. As the consequence, the market situation has been changing dramatically since this point.

3.4 Measuring Underwriter Syndicates

The most byzantine problem is how to measure the syndicates, given that their sizes and members are highly divergent within the syndicate sample. Careful examination of the microstructure of the syndicates shows that there are normally two roles represented in one syndicate. Some underwriters are lead underwriters and others are member of the syndicate. For example, in the IPO case of Sinocom Software Group Ltd., listing code 0299, there are 5 underwriters in the syndicate. As illustrated in Figure 3.1, Daiwa Securities is the lead underwriter. Guotai Jun'an Capital

Limited and First Shanghai Securities are co-lead underwriters in this syndicate. The members are Japan Asia securities and UOB Kay Hian (HK).

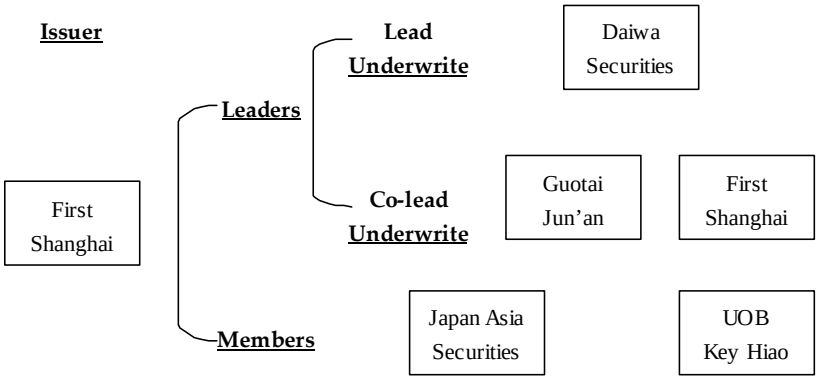

Figure 3.1: The structure of underwriter syndicate: an example

In this section we concentrate on the following questions. First, do underwriter syndicates have the best connection to the issuers' target investors? Here the term "target investors" refers to those who have shown their interest in the IPO firm, or have a potential interest in the offering. As investors' potential interest is difficult to capture, those investors who have shown interest in the same industry sector (by trading shares) is regarded as the target investors. Second, do underwriter syndicates have enough information, experience and knowledge to set the initial offering price of the shares being issued? In order to gain the knowledge of pricing, underwriters are supposed to have extensive experience in issuing shares, especially shares in the same industry. Third, is the leading underwriter capable of the proper conduct and management of the syndicate? A high-quality leader will always guarantee a better

Rank	Name	Freq
1	First Shanghai Capital Limited	137
2	Guotai Junan Securities (HK) Limited	113
3	Kingsway Sw Securities Limited	105
4	Tai Fook Capital Limited	93
5	Core Pacific - Yamaichi International (HK) Limited	93
6	Sun Hung Kai International Limited	92
7	Kingston Securities Limited	79
8	CSC Securities (HK) Limited	76
9	DBS Asia Capital Limited	71
10	Celestial Capital Limited	71

Table 3.1: Top 10 underwriters by number of cases

outcome. It is thus reasonable to expect the leading underwriter to have more experience of the underwriting business than others in the syndicate, and hence to have gained the ability from that experience to be a better leader.

3.4.1 Ranking underwriters by frequency

To start investigating specific features, a measuring system should be established at the outset. By collecting the names of underwriters from IPO prospectuses, the underwriter database has been created in this research. Table 3.1 shows the top 10 underwriters measured by the frequency of their appearance in the IPO cases, and the full ranking list is given in Appendix 3.C.

The result of ranking underwriters by frequency is quite remarkable since the international big names, such as Goldman Sachs, Lehman Brothers, Morgan Stanley or Merrill Lynch, are not included in the top 10 list. Instead, some local investment banks, such as First Shanghai Capital Limited, Guotai Junan Securities (Hong Kong)

Limited, and Kingsway Sw Securites Limited, take most of the positions in top 10 list. In addition, within the top 10 underwriters the number of their cases drops quickly, as the number of cases of the underwriters ranked lowest is only about one half of the number of top one.

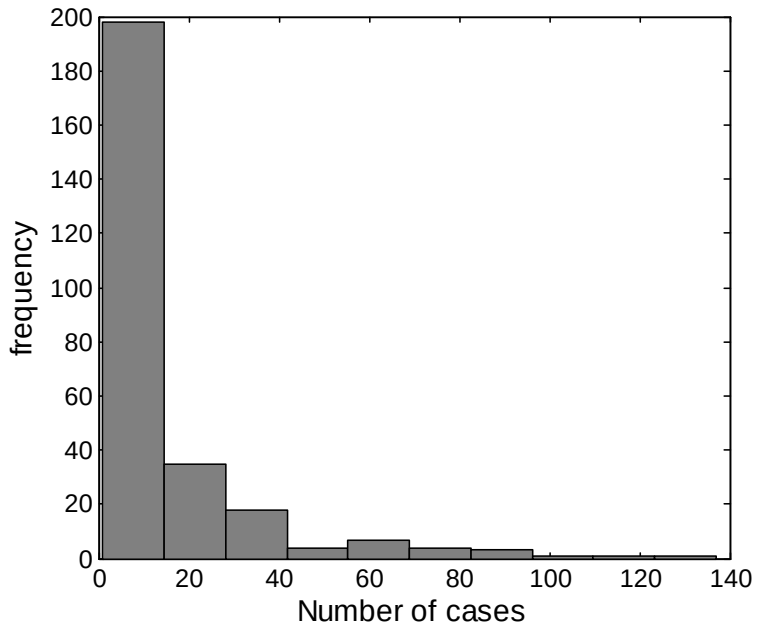

Figure 3.2: Distribution of the number of cases that underwriters are involved.

Figure 3.2 illustrates that in the underwriting business, some underwriters do have monopolistic power. First Shanghai Capital Limited, taking first place in the ranking, has been involved in 137 IPO cases, which is greater than a quarter of the total number of cases in the whole sample. Moreover, Celestial Capital Limited, the

Industry Sector	Name	Freq
Electronic, Electrical Equip.	Oriental Patron Asia Limited	7
	First Shanghai Capital Limited	7
	CSC Securities (HK) Limited	6
	Guotai Junan Securities (HK) Limited	5
	DBS Asia Capital Limited	5
General Retailers	Sun Hung Kai International Limited	4
	First Shanghai Capital Limited	4
	DBS Asia Capital Limited	4
	Dao Heng Securities Limited	4
	Tai Fook Capital Limited	3

Table 3.2: List of "industry experts" underwriters (part).

last underwriter in the top ten, is involved in more than one eighth of all cases. These figures illustrate the high concentration of power in underwriting business.

Since the underwriting business is non-exclusive, it is impossible to measure the market share of every underwriter. As the consequence, the Herfindahl-Hirschman Index (HHI), the indicator widely used to measure competitiveness among the firms in the market, does not apply here in the underwriting business.

Table 3.2 shows the most active (top five) underwriters in two selected industries, the full list being given in Appendix 3.D. In “Electronic and Electrical Equipment” industry sector, for instance, the frequencies of the underwriters in the top five are all similar to each other. According to the full list of active underwriters in different industries, we define the top five most active underwriters in an industry as the

"industry expert underwriters", since it is reasonable to believe that the most active underwriters in one industry are able to gain better knowledge from their experience.

Definition 1 *If underwriter U_i is one of the industry expert in industry j, we define the expert property as follow.*

$$U_i(j) = 1$$

otherwise,

$$U_i(j) = 0$$

3.4.2 Industrial coverage

Since one of the key features of the underwriter syndicate is that syndicates possess a better knowledge of market conditions, and thus the ability to set a more accurate offering price, it is a basic requirement that the members of a syndicate should be able to cover more potential investors. As we assign the industry expert property as being an industry expert to every underwriter, it is reasonable to believe that a syndicate with more industry experts in its team is more informed about the market's conditions. Let syndicate $R_s(U_1^s, U_2^s, ...U_{n_s}^s)$ consist of n_k underwriters. For a certain underwriting syndicate, we define the industrial coverage as follow.

Definition 2 *For a syndicate $R_k(U_1, U_2, ...U_{ns})$ the industrial coverage of the syndicate IC_k is*

$$IC_k = \sum_{j=1}^{j_{\max}} (\sum_{ki=1}^{kn} U_{ki}(j))$$

where j represents a different industry. And for the same j, only the first $U_{ki}(j) = 1$ counts.

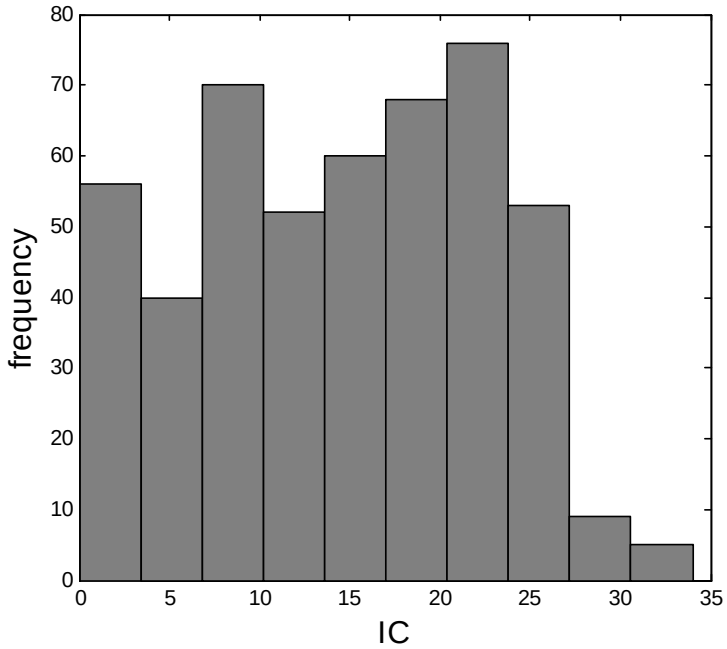

Figure 3.3: The distribution of variable IC.

Figure 3.3 illustrates the distribution of the industrial coverage of the underwriter syndicates. The average value of industrial coverage is 14.56 out of 34 industry sectors. It is clear that only a small number of syndicates achieve industrial coverage of more than 25, indicating that the business is quite concentrated and that a small group of underwriters take most of the market share.

3.4.3 Syndicate expertise

In order to set the best offering price and investigate the market demand for shares within a certain industry, syndicates are expected to be experts in the issuers' industry.[24] Otherwise, it is reasonable to believe syndicates could not price the IPO shares properly, thus leaving issuers and themselves exposed to the risks of the market. Here we define syndicate expertise industry as follow.

Definition 3 *The most covered industry sector J for a certain syndicate k is defined by following relationship:*

$$\sum_{ki=1}^{ki_n} U_{ki}(j) = \max\{\sum_{ki=1}^{ki_n} U_{ki}(j), j \in (0, j_{\max})\}$$

The syndicate "expertise industry" variable SE takes the value 1 if the most covered industry sector J of a certain syndicate is the same as the issuer's industry sector, and 0 otherwise. Figure 3.4 demonstrates statistical information about the industrial expertise of the underwriter syndicate. Among 489 syndicates, only 80 syndicates' expertise in industry is not the same as for the issuers. The dominant number of syndicates have the same industrial expertise as that of their clients.

3.4.4 Leaders' competence

As previously explained, there are normally two roles in a syndicate: those of the members and the leader. A leading underwriter usually plays a more important role than the other members, and also takes a greater proportion of the commission fee.

[24] At least one member of syndicate has to be an expert.

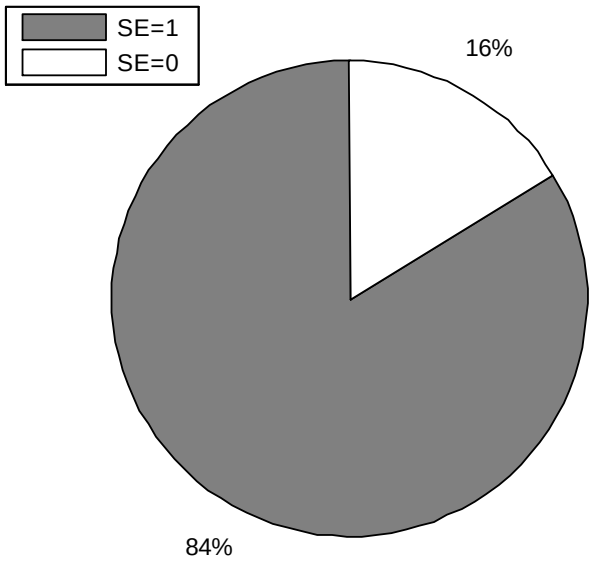

Figure 3.4: The distribution of variable SE.

Out of hundreds of underwriters, the issuer must be careful to select the best leading underwriter. The basic criteria for selection of the leading underwriter should be as follows. First, the leading underwriter is expected to be able to manage the syndicate and introduce appropriate underwriters to the syndicate. Second, the leading underwriter should be of high reputation in order to signal the quality of the underlying assets behind the IPO shares. To represent these two requirements we use the rank on the frequency list of the total number of IPOs (Appendix 3.C), which is related to the suitability of a leading underwriter. This notion is in accordance with the previous observation by Hayes (1971). Hayes discovers that the investment banking industry

is characterised by an intrinsic hierarchy. The privileged investment banks have considerable strength, particularly in the underwriting business. In addition, he suggests that an investment bank establishes its own reputation in the following ways: relying upon the partner's reputation, the capital strength of the bank itself, and its ability to distribute securities. We define the lead underwriters' competence in this research as follows.

Definition 4 *If the most highly ranked underwriter by frequency of participation in IPOs is the leading underwriter in a syndicate, we define*

$$LC_k = 1$$

Otherwise,

$$LC_k = 0$$

As shown in Figure 3.5, the competent leaders' group dominates the syndicate sample. Only 27 syndicates out of 489 do not choose the most highly ranked underwriter as their lead underwriter. The proportion of the "Leader Competence" is much greater than the "Industrial Expertise" group in Figure 3.4, suggesting that from an issuer's perspective the choice of a leading underwriter with the highest reputation is to be preferred when constructing an IPO syndicate.

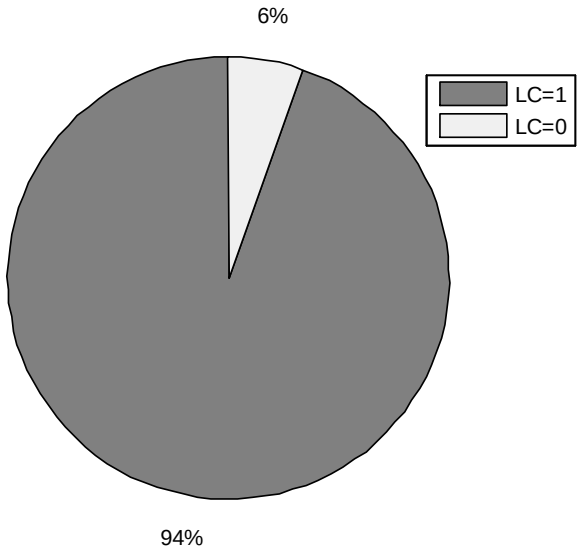

Figure 3.5: The distribution of variable LC.

3.4.5 Discussion

As the main purpose of the underwriting business is to sell IPO shares, the quality of the underwriter syndicate is an important factor in the IPO's performance. The measurements in this research, including industrial coverage (IC), industrial expertise (SE) and leader competence (LC) construct the basic framework of the syndicate analysis. In order to understand the impact of the syndicate's properties on IPO performance, we run regression tests on the underpricing level (UP) and the oversubscription ratio ($Oversub$), both of which are widely accepted measures of IPO performance. We define the underpricing level as follows:

$$UP = \frac{P_{open} - P_{offer}}{P_{offer}}$$

where P_{open} and P_{offer} refer respectively to the first trading day open price and the offer price in the primary market of a certain offering. The variable $Oversub$ represents the demand from the investors in the primary market and is calculated as follows:

$$Oversub = \frac{N_{sub}}{N_{offer}}$$

where N_{sub} and N_{offer} refer respectively to the number of shares subscribed by investors and shares offered by issuer in primary market. The underpricing level represents the level of mispricing of the IPO shares. Although some people believes that a certain level of underpricing is necessary for many purposes, including choosing target investors and stimulating secondary market liquidity, severe underpricing of IPO shares ultimately leads to extra cost for the issuer and turns out to be inefficient. In addition, attempts that try to separate the necessary underpricing level from inefficient underpricing have never been successful in the existing literature. As a result, we use the underpricing level as the level of cost for issuers.

At the aggregate level, besides the liquidity shocks caused by large block selling and by capitalisation of the IPO, the underpricing level is less severe when a syndicate is expert in the issuer's industry. This can be seen on the Table 3.3 where there is a negative correlation between the variable SE (indicator of industry specific syndicate) and underpricing level. The result also illustrates that a better leader in the syndicate (LC) and more industrial coverage (IC) is associated with a lower level of underpricing, although the relationship between them is insignificant.

The degree of oversubscription is also a principle means of measurement of an offering. A successful underwriter syndicate is supposed to be able to encourage enough investors in the primary market. However, although oversubscription is an important indicator for IPO performance, there is no universal optimal level for oversubscription. Normally investors expect a moderate oversubscription ratio. An extreme high oversubscription level suggests the offer price might be unreasonably low, and further reveals that the underwriters are incapable of pricing the equity. A severely low oversubscription ratio implies that it is possible that the offering is facing serious difficulties in the primary market, and that the underwriters are incapable of promoting the offering. Table 3.4 shows that the oversubscription is significantly influenced by the variable LC, suggesting that strong leadership is the determinant factor on the primary market performance. In addition, the coefficient signs of variable LC vary in different industries, suggesting that the syndicates' impact diverges with regard to the industry level.

Dependent Varable: UP

Industry Sector	Software & Computer Services		Personal Goods		Technology Hardware & Equip.		Media		Aggragate Level	
	Coef	StdError	Coef	StdError	Coef	StdError	Coef	StdError	Coef	StdError
Ln(CAP)	1.323 **	0.314	0.016	0.014	0.092	0.099	0.018	0.023	0.230 **	0.054
IC	-0.013	0.062	0.000	0.002	-0.022	0.022	0.001	0.004	-0.023	0.013
SE	a		a		a		a		-0.505 *	0.251
LR	5.547	3.316	-0.081	0.088	-0.322	0.665	-0.054	0.168	0.242	0.431
SyndSize	-0.096	0.096	0.012 **	0.005	0.112 **	0.035	-0.003	0.010	0.018	0.023
Const	-27.816 **	7.349	-0.244	0.295	-1.797	2.029	-0.171	0.461	-3.589 **	1.159
Sig.(2-tailed)		0.003 **		0.134		0.035 *		0.851	0.000	**
Adjusted R Square		0.234		0.091		0.207		0.060	0.040	

** Significant at 5% level

* Significant at 10% level

[a] Variable is deleted because of being constant or having missing correlations in the specific industry sector

Table 3.3: Regression test on the relationship between underpricing level and IPO performance

Dependent Varable: Oversub

Industry Sector	Software & Computer Services		Personal Goods		Technology Hardware & Equip.		Media		Aggragate Level	
	Coef	StdError	Coef	StdError	Coef	StdError	Coef	StdError	Coef	StdError
Ln(CAP)	4.6	11.7	33.8	23.2	9.0	7.8	29.8	19.3	18.6 **	3.5
IC	0.2	1.8	2.4	3.8	-4.7 *	2.1	-0.4	3.4	1.0	0.8
SE	[a]		[a]		[a]		[a]		-4.8	16.2
LC	-126.0	86.2	-59.7	142.4	142.3 **	50.7	79.1	136.3	-89.4 **	26.3
SyndSize	0.4	2.7	2.1	7.7	-4.5	2.5	-14.3	8.8	-0.1	1.4
Const	58.7	261.4	-562.4	479.5	-161.1	160.1	-458.2	378.8	-230.1 **	74.7
Sig.(2-tailed)		0.5		0.3		0.0 **		0.2	0.0	**
Adjusted R Square		0.0		0.0		0.4		0.1	0.1	

** Significant at 5% level

* Significant at 10% level

[a] Variable is deleted because of being constant or having missing correlations in the specific industry sector

Table 3.4: Regression test on the relationship between Oversub and IPO performance

3.5 Underwriter Network Analysis

Up till now, the structure of the underwriter network remains unclear, and regarding the questions about why and how the underwriters form syndicates we are still left in the dark. This section focuses on the structure of the underwriter network and discusses the detailed analysis performed by implementing the cutting edge network analysis techniques.

In a network, we assume that the nodes are connected to each other by undirected lines. Here we define the undirected lines as that the nodes are equally weighted at both ends of the links. In the underwriter network, the nodes are the individual underwriters and the links are defined as the pair-wise connection when two underwriters cooperate in a syndicate. Again, we take Sinocom Software Group (listing code: HK0299) as an example. As shown in Figure 3.1, the five underwriters in the syndicate cooperate in this IPO. Consequently, the underwriters in the syndicate have a cooperative relationship in this syndicate. Normally, underwriters are involved in many syndicates and have cooperative relationships with various other underwriters. The purpose of this analysis is to characterise the complex relationship network and discover the nature of the underwriting business network.

Further to examining the analysis techniques, we review and report an attempts to implement various types of network analysis methods, including the ultra-matrix[25], binary-tree, etc. Among the different types of network, the random graph is the most

[25] The ultra-matrix method has been implemented in Noah's ark problem analysis (Weitzman, 1998), biodiversity studies (Brown and Shogren, 1998).

adaptive technique used in describing underwriter networks. Random graph theory has been implemented in many network analyses to describe the statistical properties of graphs, such as distributions of sizes, and typical average nodes distance. Random graph theory has also been powerful in analysing social collaboration networks, such as boards of directors in companies, co-ownership networks of firms, collaborations of scientists in research and even movie actors' networks. However, the traditional random graph theory cannot fit the empirical data used here perfectly. In this research, we use adapted random graph theory (Newman et al., 2001), which has been proved to be more convincing in exploring collaborative networks than the classic theory.

Since the underwriter network is a collaborative one, in order to implement the random network analysis, it is necessary to adapt the collaborative relationships among nodes into pairwise relationships. The details of this adapting are explained in Figure 3.6.[26]

3.5.1 The random graph with arbitrary degree distribution

Here we give a brief overview of the theory of the random graph with arbitrary degree distribution. In random graphs, it is assumed that the existence of links between any two nodes is independent of the existence of any other links. As a consequence, the existence of the link is solely dependent on the probability p. For a network with N nodes and the average probability of a link from one node is z, we have

[26] The graph is adapted from Newman, Strogatz and Watts (2001)

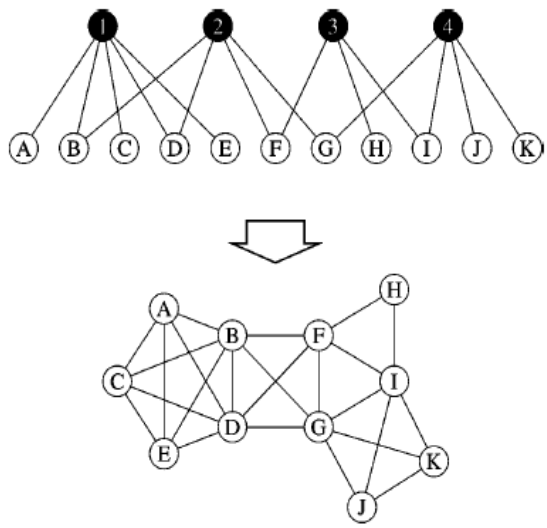

Figure 3.6: The adaption from a collaborative to a pairwise network.

$$p = \frac{z}{N-1} \approx \frac{z}{N} \text{ when } N \text{ is large}$$

For an individual node, the probability distribution p_k can be calculated as follows for the edges connected by k links:

$$p_k = \binom{N}{k} p^k (1-p)^{N-k} \approx \frac{z^k e^{-z}}{k!} \text{ when N is large}$$

which is a typical Poisson distribution. Suppose we have an undirected graph of N nodes, and N is large. The generating function $G_0(x)$ is defined as follows:

$$G_0(x) = \sum_{k=0}^{\infty} p_k x_k,$$

where the p_k is the probability, and the generating function $G_0(x)$ represents the aggregate probability distribution of nodes with k connections. The generating function is normalised so that

$$G_0(1) = 1.$$

In this setting, the distribution can be written as the following equation for the probability r_z of having z as the size of group:[27]

$$r_z = \frac{\gamma^z}{z!} e^{\mu(e^{-\gamma}-1)} \sum_{k=1}^{z} \left\{ {z \atop k} \right\} [\mu e^{-\gamma}] k, \tag{3.1}$$

where the coefficients $\left\{ {z \atop k} \right\}$ are the Stirling numbers of the second kind

$$\left\{ {z \atop k} \right\} = \sum_{r=1}^{k} \frac{(-1)^{k-r}}{r!(k-r)!} r^z$$

and μ, γ are the average size of groups related for each node and the average size of groups.

3.5.2 Empirical results

Figure 3.7 illustrates the distribution of the sizes of the underwriting syndicate in the sample, and the distribution is clearly double peaked. The first peak is around the point where the size equals 3, and the other one is around the point where the size is between 6 and 7.

[27] The proof of equation (3.1) is in Appendix A, adapted from Newman, Strogatz and Watts (2001).

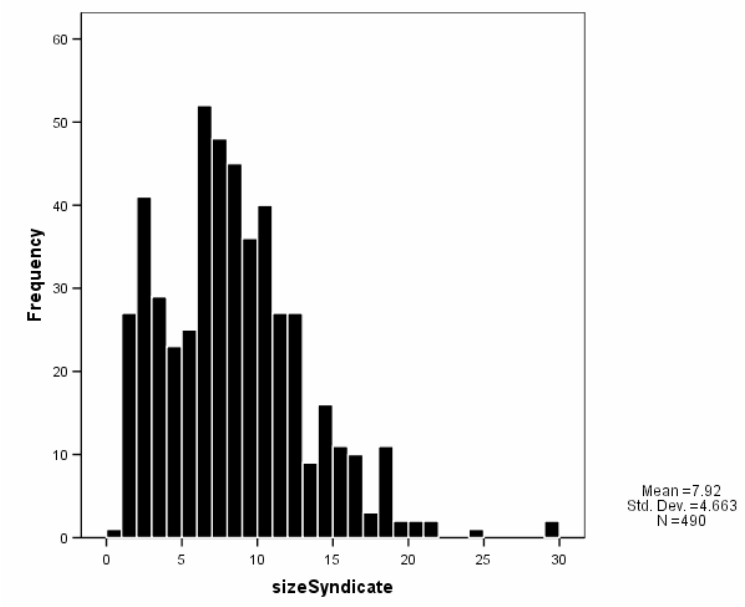

Figure 3.7: Distribution of underwriting syndicate size

In the first place, we assume that the underwriter network is a single united network. Figure 3.8 illustrates the simulation result obtained by setting the parameters according to the data sample. In the figure, the left axis represents the frequency of a given syndicate size, and the right axis represents the simulated probability for different syndicate sizes under the random graph settings. Although single peaked simulation fits the empirical data well both at the left end of the graph and the right end of the graph, however, it does not fit the part of the data when syndicate size is from 3 to 6. As a result, the single peaked assumption is not accepted and a further test using a double peaked simulation hypothesis is needed. To identify the presence of a double peaked distribution, we perform additional analysis of the relationship between the distribution of syndicate size and the performance of IPOs as follows:

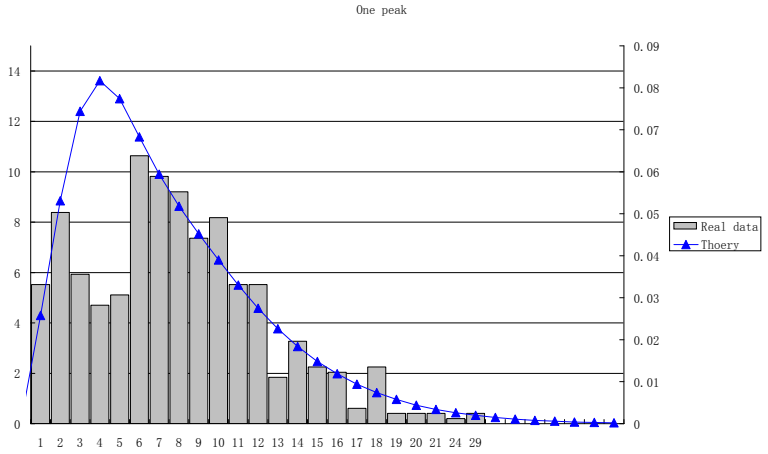

Figure 3.8: Single peaked simulation and the distribution of syndicate size.

In the double peaked simulation, the significant difference is that there are two semi-groups in this simulation. First, it is assumed here that the syndicates are totally separated into two groups, named group A and B. Secondly, this separation means that the following rule applies in the double peaked simulation: the underwriter syndicates in group A act in a way which is independent of their peers in group B, and syndicates in group B act independently of their peers in group A. Another important issue is to identify the right size of the group. Since it is clear that the separating line lies at around size 5, the following analysis helps to identify the exact position of the separating line:

C is a dummy variable representing different groups. In the first correlation test, we assume that the syndicates with a size equal to or smaller than 4 are in group A, and the other syndicates are in group B. In the second test, group A contains the syndicates with size smaller than or equal to 5 and group B contains other syndicates.

*Define C=1 if Syndicate size>4, C=0 otherwise

Variables			Volume	OverSub	CapOffer	UP
Kendall's tau_b	C	Correlation Coefficient	0.10328183 **	0.1092051 **	0.22408805 **	-0.0292289
		Sig (2 tailed)	0.00709729	0.00599997	0.000001	0.44956567
		N	455	0.10328183	490	455
Spearman's rho	C	Correlation Coefficient	0.12635329 **	0.13344413 **	0.273401 **	-0.0354874
		Sig (2 tailed)	0.00696281	0.0058647	0.000001	0.45017263
		N	455	425	490	455

**Define C=1 if Syndicate size>5, C=0 otherwise

Variables			Volume	OverSub	CapOffer	UP
Kendall's tau_b	C	Correlation Coefficient	0.0600929	0.06986187	0.1716425 **	-0.0113391
		Sig (2 tailed)	0.11724566	0.07877451	3.6417E-06	0.76926336
		N	455	425	490	455
Spearman's rho	C	Correlation Coefficient	0.12635329 **	0.13344413 **	0.273401 **	-0.0354874
		Sig (2 tailed)	0.00696281	0.0058647	0.000001	0.45017263
		N	455	425	490	455

Table 3.5: Identifying the seperating line between two sub-groups

The correlation tests indicates that the dummy variable C is significantly correlated with other identical variables in the first correlation test. Those variables are indicators of IPO performance. The variable Volume refers to the volume of shares offered in the IPO. $CapOffer$ is the capitalisation of the IPO shares with the offer price in the primary market. The variables UP and $OverSub$ are defined as in the previous section.

The virtual separating line is not only clear in the correlation test, but significant in the figures. The following figures illustrate the relationships between the size of the syndicate and other factors.

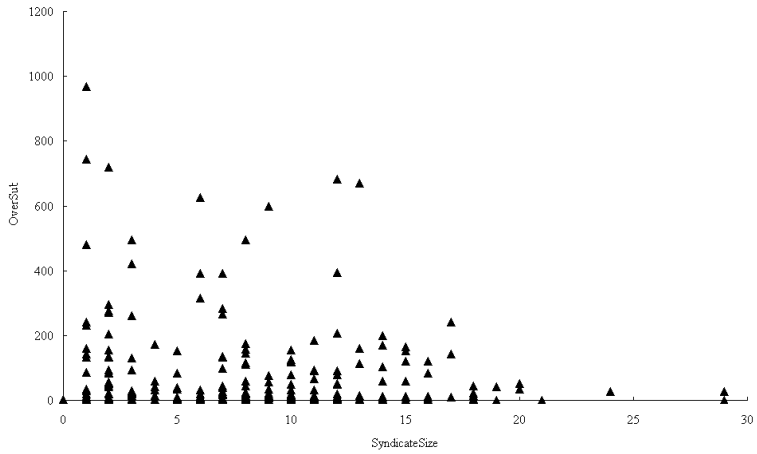

Figure 3.9: The distribution of $Oversub$ and size of syndicates

In Figure 3.9, the separation of the two groups of syndicates is clear. To the left hand of the line where the $size$ is equal to 5, the frontier of variable $Oversub$ decreases along with the increasing size. Yet on the right hand of the line where the

$size$ is equal to 5, the trend of the frontier of $Oversub$ is not as clear as it is to the left. The maximum value of $Oversub$ falls in the left hand group. Since the variable $Oversub$ represents the demand of the investors for the IPO shares, the distribution indicates that the underwriter syndicate in the left group are more likely to stimulate greater demand in respect of the subscription in the primary market for IPO shares.

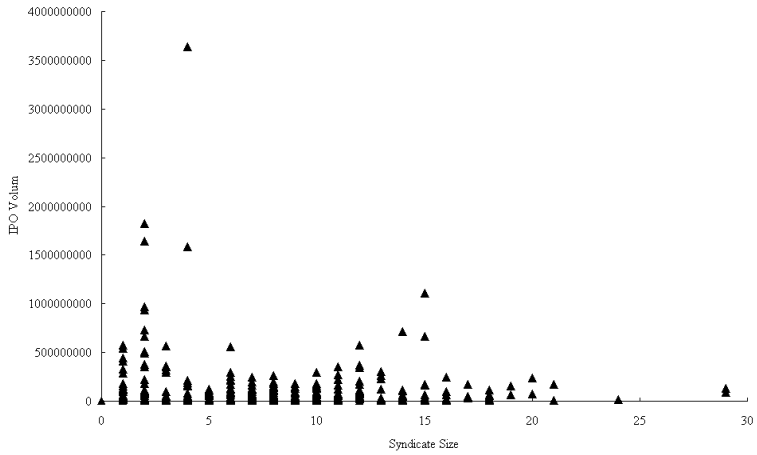

Figure 3.10: Distribution of IPO Volume and Size of Syndicates

The result shown in Figure 3.10 is somehow surprising. Traditionally, people have believed that the reason for having a syndicate rather than an individual underwriter is that an individual underwriter is not able to deal with huge cases. Conversely, Figure 3.10 shows that most huge cases, measured by volume, are underwritten by the smaller syndicates. We would like to propose here a possible reason for this empirical result: underwriters are now able to carry on large cases normally while they are syndicating for some other purposes. At the beginning of the 20th

century, underwriters were not able to deal with huge offerings. Yet it is not difficult now to understand why the underwriters have greater power to raise funds and distribute equities, given the dramatic progress in information technology that has been implemented in the financial industry. Information technology makes individual underwriters capable of gathering much precise market information and distributing a great number of IPO shares. It is quite likely that the reputable underwriters only cooperate with other underwriters with high reputations, and that underwriters with low reputations can only work with those with low reputations.

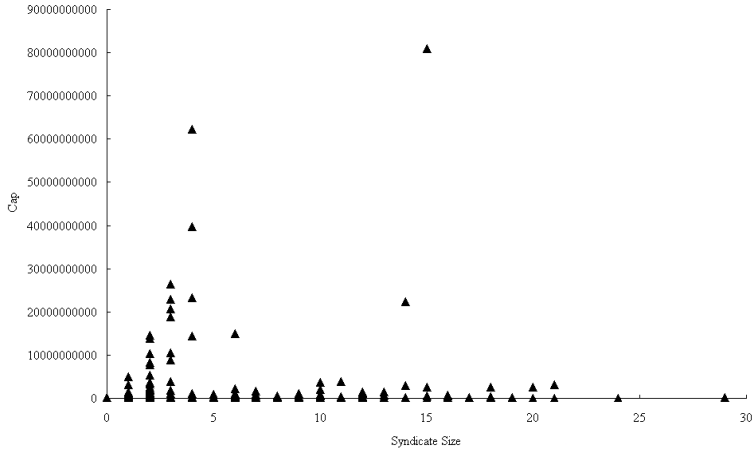

Figure 3.11: Distribution of IPO capitalization and size of syndicates.

The separation is also in Figure 3.11, showing that the capitalisation's maximum limit before the line where size is equal to 4 rises with the increase of syndicate size, and that the capitalisation limit drops sharply at the point where the size is equal to 5. Except for some extreme cases around the point when size is at 15, most of the

IPOs with a greater syndicate (more than 5) are relatively small in term of capitalisation.

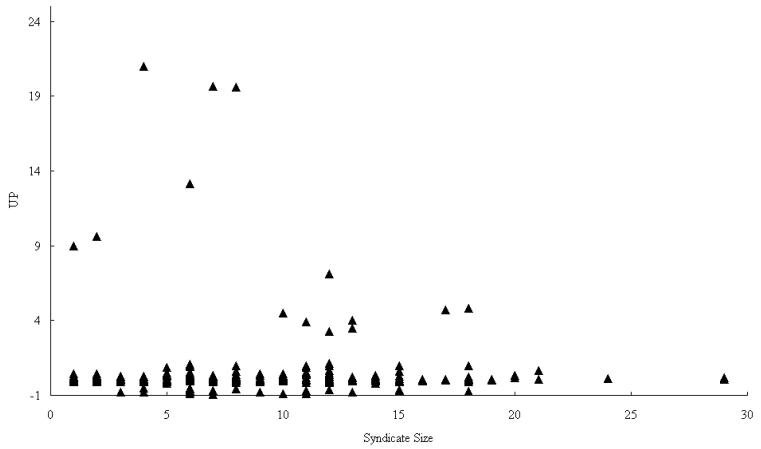

Figure 3.12: Distribution of underpricing and the size of syndicates

As Figure 3.12 indicates, the size of the syndicate is essentially not relevant to the underpricing level and the two groups of underwriter syndicates are not significantly influential to the underpricing level. Since the major concern of investors in IPO is the initial return of IPO shares, this result from the Hong Kong market is consistent with the previous observations documented by Logue et al. (2002), that the reputation of the underwriters in the syndicate is not directly relevant to the investors.

Following discussion the segmented network assumption, we simulate the distribution results of syndicates' size under a two sub-groups network. Detailed information about the simulation of a two sub-groups underwriter network is presented in

Appendix 3.B. Figure 3.13 illustrates the distribution and shows that the simulation result fits the empirical result.

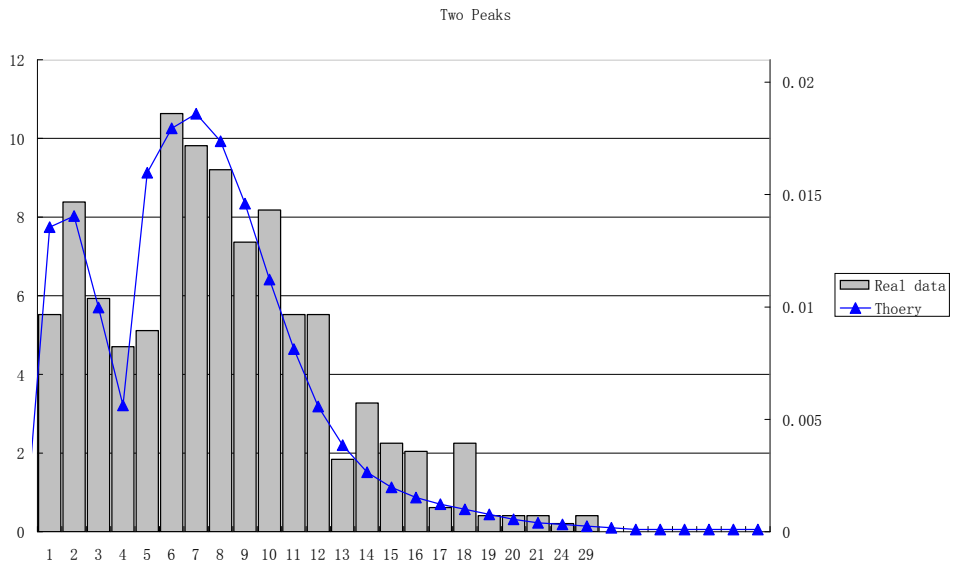

Figure 3.13: Double peaked simulation and the empirical distribution of syndicate size.

3.5.3 Remarks

In this section, we identified the sub-groups in the underwriter network using random graph analysis of data from the Hong Kong equity market. In the two sub-groups, underwriter syndicates do not only differ in size, but also vary significantly in IPO outcomes, including the offering sizes and oversubscription ratio. It is likely that the underwriters gather into different groups according to their reputation, and reputable underwriters usually form smaller syndicates.

Yet some questions remain after the identification of sub-groups. First, is this phenomenon unique to the Hong Kong market, or also true for other financial markets? Additional empirical evidence is needed to answer this question. At the moment, few existing financial databases include relevant information on syndicates, given that academic scholars and practitioners in financial industry have long neglected the importance of the underwriting business. Second, the reason why underwriters are divided into different sub-groups is unknown. It is possible that this is the result of long-term market selection (such as natural selection). Allowing privileged underwriters to enlarge their advantage in the business by using their reputation and those of their syndicate partners, underwriters are polarised into highly reputable sub-groups and less reputable sub-groups. Third, the reason why bigger syndicates are not able to sufficiently utilise their advantage of having better information to set more accurate offering prices is unknown. These remaining questions open avenues for further studies.

3.6 Concluding Discussion

In the majority of the literature about the IPO-related puzzles, underwriter syndicates have not yet been critically examined. Scholars have ignored the importance of the structure of the underwriting business and this ignorance has led to the following difficulties in the current research. First, to my knowledge no comparable results can be used for reference for this research into the nature of underwriter syndicates

and networks. Nevertheless, some research papers do mention the importance of the underwriter syndicate and network, such as Carter and Manaster (1990), and Hu and Ritter (2007). These authors emphasise the importance of the reputation of the syndicate, or of the analyst resource. Second, underwriter syndicate data are not widely available. In some leading financial databases, only very limited data on equity underwriting syndicates, such as the size of syndicates in the U.S. and Canadian market, are available.

Some earlier research focused on the relationship between the underwriters' reputation and the IPO performance, reflected in the after market liquidity, underpricing level, and the long term performance. Yet this research selected the most reputable underwriters in the syndicate or among the managing underwriters (lead managing underwriters or co-managing underwriters). The interactions among underwriter syndicates were disregarded and individual member underwriters were not taken into account in those studies. Based on the subjective definition of the reputation of the underwriter syndicates, those investigations may have led to imperfect outcomes.

This chapter examined the structure of underwriter syndicates and presents in detail ways of measuring the syndicates by considering both lead and member underwriters. Using these measurements, the regression test illustrates that IPO performance is related to the underwriter syndicate, while the relationship is not significant with all parameters and in different levels. In addition, the distribution of

syndicate size shows that there are sub-groups in underwriter networks and that the performance of syndicates in the two sub-groups differs significantly. This finding is consistent with the hierarchy theory of Hayes (1971) and the argument that a larger syndicate is usually associated with a lower analyst influence (Hu and Ritter, 2007). Although it remains unclear whether the grouping phenomenon is unique to the Hong Kong equity market, the research presents evidence that one single underwriter cannot characterise the entire syndicate. Research which employs only one underwriter to represent the whole syndicate might therefore be potentially misleading. Above all, this chapter shows that the perspective from the point of view of underwriter syndicate is not only interesting, also necessary to understand underwriting business and IPO performance.

3.A The Distribution of Syndicate Size in A Single Group

Let us assume that in a undirected graph, every edge between any two vertices is independently present or absent of any other edges, and the probability of the independent present of the edge is p. If there is a graph with N vertices, the average number of edges between vertices should be $z = p(N-1)$. If we define the number of edges connected to any particular vertex k, then the probability p_k should be

$$p_k = \binom{N}{k} p^k (1-p)^{N-k} \overset{N\to\infty}{\simeq} \frac{z^k e^{-z}}{k!}.$$

Then the generating function $G_0(x)$ for the probability distribution of vertex degree k should be defined as:

$$G_0(x) = \sum_{k=0}^{\infty} p_k x^k$$

Since the distribution p_k is assumed to be normalized, we have

$$G_0(x) = 1.$$

In this setting, the probability p_k is given by the kth derivative of $G_0(x)$.

In a Poisson distributed graph, the distribution leads to a standard random graph. As N is a large number, $p = \frac{z}{N}$. $G_0(x)$ is given by

$$G_0(x) = \sum_{k=0}^{N} \binom{N}{k} p^k (1-p)^{N-k} \simeq e^{z(x-1)}$$

Consider in a bipartite graph of M IPOs and N underwriters, we define the average number of IPOs involved for underwriters as μ, and the average size of IPO as ν, so we have

$$\frac{\mu}{M} = \frac{\nu}{N}.$$

Thus, we can define the generating function for the number of IPOs involved for underwriters $f_0(x)$ and the size of IPOs $g_0(x)$ as

$$f_0(x) = \sum_j p_j x^j \quad g_0(x) = \sum_k q_j x^j$$

Consider a Poisson-distributed numbers of both $f_0(x)$ and $g_0(x)$, we have

$$f_0(x) = e^{\mu(x-1)} \quad g_0(x) = e^{\nu(x-1)}$$

so $f_1(x) = \frac{df_0(x)}{dx} = f_0(x)$ and $g_1(x) = \frac{dg_0(x)}{dx} = g_0(x)$. We find that the generating function for the graphs is:

$$G_0 = f_0(g_1(x)) = \exp[\mu(e^{\nu(x-1)} - 1)]$$

We can then perform derivative and setting $x = 0$. For the probability r_1 of syndicate size 1, we find

$$r_1 = G_0'(x) = \mu\nu e^{-\nu} e^{\mu(e^{-\nu}-1)}$$

and for the probability r_2 of syndicate size 2, we find

$$r_2 = G_0''(x) = \nu^2 e^{\mu(e^{-\nu}-1)}(\mu e^{-\nu} + \mu^2 e^{-2\nu})$$

So the probability r_z of syndicate size z should be

$$r_z = \frac{\gamma^z}{z!} e^{\mu(e^{-\gamma}-1)} \sum_{k=1}^{z} \left\{ {z \atop k} \right\} [\mu e^{-\gamma}]k \tag{3.2}$$

where the coefficients $\left\{ {z \atop k} \right\}$ are the Stirling numbers of the second kind

$$\left\{ {z \atop k} \right\} = \sum_{r=1}^{k} \frac{(-1)^{k-r}}{r!(k-r)!} r^z.$$

3.B The Distribution of Syndicate Size under Two Subgroups

Consider now we have two independent groups of underwriters, group A and B, where underwriters only cooperate with the underwriters within the same group. The average number of IPOs involved for underwriters as μ_A and μ_B, and the average size of IPO as ν_A and ν_B in group A and B accordingly. For the syndicate size z, we find the aggregate probability r_z as

$$r_z = \lambda_A r_{zA} + \lambda_B r_{zB}$$

where λ_A and λ_B are the proportion of IPOs in group A and B. The r_{zA} and r_{zB} can be derived from the equation (3.2).

3.C Overall Rank of Underwriters by Number of Cases

Underwriter	Frequency	Underwriter	Frequency
First Shanghai Capital Limited	137	First Asia Financial Group Limited	19
Guotai Junan Securities (HK) Limited	113	Emperor Securities Limited	19
Kingsway Sw Securities Limited	105	Young Champion Securities Limited	18
Tai Fook Capital Limited	93	Sinopac Securities (Asia) Limited	18
Core Pacific - Yamaichi International (HK) Limited	93	Partners Capital International Limited	18
Sun Hung Kai International Limited	92	Anglo Chinese Corporate Finance Limited	18
Kingston Securities Limited	79	Sinpac Securities (HK) Limited	17
CSC Securities (HK) Limited	76	Pacific Challenge Capital Limited	17
DBS Asia Capital Limited	71	Japan Asia Securities Limited	17
Celestial Capital Limited	71	BCOM Securities Company Limited	17
Shenyin Wanguo Capital (HK) Limited	63	Christfund Securities Limited	16
SBI E2-Capital Securities Limited	62	AMS Corporate Finance Limited	16
BNP Prime Peregrine	60	Taiwan Concord Capital Securities (HK) Limited	15
South China Capital Limited	58	Pacific Foundation Securities Limited	15
JS Cresvale International Limited	58	Tanrich Securities Company Limited	14
Oriental Patron Asia Limited	57	Merrill Lynch Far East Limited	14
ICEA Capital Limited	56	Phillip Securities (HK) Limited	13
BOCI Asia Limited	54	Daiwa SBCM HK	13
Kim Eng Securities (HK) Limited	51	Yuanta Securities (HK) Company Limited	12
Barits Securities (HK) Limited	51	TingKong-RexCapital Securities International Limited	12
TIS Taiwan International Securities (HK) Limited	48	The Bank of East Asia, Limited	12
Phoenix Capital Securities Limited	41	Sino Grade Securities Limited	12
Polaris Securities (HK) Limited	40	New Japan Securities International (HK) Limited	12
HSBC Investment Bank Asia Limited	38	Karl-Thomson Securities Company Limited	12
KGI Asia Limited	36	ING Barings	12
GC Securities Limited	36	Goldbond Capital (Asia) Limited	12
Dao Heng Securities Limited	36	G.K. Goh Securities (HK) Limited	12
Sanfull Securities Limited	35	Credit Suisse First Boston (HK) Limited	12
MasterLink Securities (HK) Corporation Limited	35	Toyo Securities Asia Limited	11
CLSA Global Emerging Markets	34	OSK Asia Securities Limited	11
Worldsec Corporate Finance Limited	33	NSC Securities (Asia) Limited	11
Koffman Securities Limited	33	HT Securities Limited	11
CEF Capital Limited	33	Grand Vinco Capital Limited	11
Vickers Ballas Capital Limited	32	CITIC Capital Market Limited	11
Luen Fat Securities Company Limited	32	Asia Financial (Securities) Limited	11
UOB Asia (HK) Limited	31	Somerley Limited	10
Taiwan Securities (HK) Company Limited	31	Sinomax Securities Limited	10
Get Nice Investment Limited	30	ABN AMRO Rothschild	10
CM-CCS Securities Limited	30	Yuanta Brokerage Company Limited	9
Core Pacific - Yamaichi Capital Limited	28	Vermont Securities Company Limited	9
Hantec Capital Limited	26	UBS Warburgh	9
CAF Securities Company Limited	26	Prudential Brokerage Limited	9
Nomura International (HK) Limited	25	Ong Asia Securities (HK) Limited	9
Goldman Sachs (Asia) L.L.C.	25	First Securities (HK) Limited	9
China Everbright Securities (HK) Limited	25	China Merchant Securities (HK) Co. Limited	9
Wintec Securities Limited	24	Asia Investment Capital Limited	9
South China Securities Limited	24	Upbest Securities Company Limited	8
China International Capital Corporation (HK) Limited	24	Yicko Securities Limited	8
Quam Securities Company Limited	23	Wocom Securities Limited	8
CU Securities Limited	22	Uni-Alpha Securities Limited	8
Cazenove Asia Limited	22	Rexcapital (HK) Limited	8
Watterson Asia Limited	21	Jardine Fleming Securities Limited	8
VC CEF Capital Limited	21	FB Gemini Securities Limited	8
Morgan Stanley Dean Witter Asia Limited	21	Crosby Limited	8
Grand Cathay Securities (HK) Limited	21	China Southern Securities (HK) Limited	8
Ever-Long Securities Company Limited	21	Worldwide Finance (Securities) Limited	7
Deloitte & Touche Corporate Finance Limited	20	Platinum Securities Company Limited	7
YF Securities Company Limited	19	Mayfair Securities Limited	7
Shun Loong Securities Limited	19	IPO Securities Limited	7
Ka Wah Capital Limited	19	Interchina Securties Limited	7

Underwriter	Frequency	Underwriter	Frequency
ING Bank N.V.	7	Great China Brokerage Limited	3
e2 Capital Limited	7	Grand Investment (Securities) Limited	3
DL Brokerage Limited	7	Goodwill Financial Service (Holding) Limited	3
Whole Win Securities Limited	6	Fuhwa Securities (HK) Co. Limited	3
Quest Stockbrokers (HK) Limited	6	Devonshire Securities Limited	3
Peace Town Securities Limited	6	Credit Lyonnais Securities (Asia) Limited	3
Lippo Securities Limited	6	Core Pacific Securities International Limited	3
Hung Sing Securities Limited	6	ASG Brokerage Limited	3
Guangdong Securities Limited	6	Advanced Partners Brokerage Limited	3
Deutsche Bank AG, Hong Kong Branch	6	Yicko GA Network Securities Limited	2
Citigroup	6	Worldvest Capital Limited	2
CCB International Capital Limited	6	Tiffit Securities (HK) Limited	2
Upsets Securities Company Limited	5	Thing On Securities Limited	2
Tung Tai Securities Co. Limited	5	Sun Delta Securities Limited	2
Stockwell Securities Limited	5	Success Talent Investments Limited	2
Salomon Smith Barney	5	South Capital Brokerage Limited	2
Open Offering Capital Limited	5	Paul Securities Limited	2
Liu Chong Hing Bank Limited	5	Pacific Pearl Securities Limited	2
JPMorgan	5	OUB Securities (HK) Limited	2
International Capital Network Limited	5	New Century Securities Limited	2
Gransing Securities Co. Limited	5	Macquarie Securities Limited	2
Coin Fall Limited	5	Lehman Brothers	2
CIMB-GK Securities (HK) Limited	5	Kay Hian Overseas Securities Limited	2
Bear Stearns Asia Limited	5	Honour Securities Company Limited	2
Baron Capital Limited	5	Hong Tong Hai Securities Limited	2
Altus Capital Limited	5	Genesis Global Strategies Limited	2
pacific foundation securities limited	4	Fulbright Securities Limited	2
Yu Ming Investment Management Limited	4	Friedmann Pacific Securities Limited	2
Standard Chartered Bank	4	Eagle Legend Securities Limited	2
Roctec Securities Company Limited	4	Dresdner Kleinwort Benson	2
Prudential-Bache Securities (HK) Limited	4	Delta Asia Securities Limited	2
Prime Securities Limited	4	Daewoo Securities (HK) Limited	2
Open IBN (HK) Limited	4	Cheung's Securities Brokers Limited	2
Onshine Securities Limited	4	Chelac Investment Company	2
New Universe Securities (HK) Limited	4	Chateron Corporate Finance Limited	2
KCG Securities Asia Limited	4	Business Securities Limited	2
Indosuez W.I. Carr Securities	4	Amsteel Securities (HK) Limited	2
Hooray Securities Limited	4	International Network Capital Limited	1
Hing Wong Securities Limited	4	Yue Xiu Securities Company Limited	1
Hani Securities (HK) Limited	4	Wellfull Securities Company Limited	1
First Sign Securities Limited	4	WAG Worldsec Corporate Finance Limited	1
EAA Securities Limited	4	Value Partners Limited	1
APC Securities Company Limited	4	V Six Securities Limited	1
Access Capital Limited	4	Troopers Securities Limited	1
Wing Hang Bank Limited	3	Tokai Tokyo Securities (Asia) Limited	1
Warburg Dillon Read	3	Times Securities Company Limited	1
Vinco Capital Limited	3	Tat Lee Securities Company Limited	1
Victorfield Securities Limited	3	Tartan Securities (Asia) Limited	1
VC Capital Limited	3	Tai Wah Securities Limited	1
Trustful Securities Limited	3	Sun Growth Securities Limited	1
TradingGuru.com Securities Limited	3	Stockmartnet Financial Services Limited	1
TISCO Securities HK Limited	3	Standard Bank Asia Limited	1
Standard Capital Limited	3	SPS Securities Limited	1
SG Securities	3	Shinko Securities (HK) Limited	1
Po Kay Securities & Shares Company Limited	3	SC Securities (Asia) Limited	1
Okasan International (Asia) Limited	3	Sassoon Securities Limited	1
Mansion House International Limited	3	President Securities (HK) Limited	1
Magnum International Securities Limited	3	OCBC Securities (HK) Limited	1
Kaiser Securities Limited	3	National Resources Securities Limited	1
Hui Kai Securities Limited	3	N M Rothschild&Sons	1

Underwriter	Frequency
Metro Capital Securities Limited	1
Malahon Securities Limited	1
Magusta Securities Limited	1
Lehin Securities Limited	1
Lee Tat & Co.	1
Kleinwort Benson Limited	1
Ke Capital (HK) Limited	1
J & A Securities (HK) Limited	1
Horwath Capital Asia Limited	1
Hing Wai Allied Securities Limited	1
Hang Seng Securities Limited	1
Grand Onward Securities Limited	1
Goldrich Securities Limited	1
GOA Securities Limited	1
Gateway Capital Limited	1
Gainwell Securities Limited	1
Fair Eagle Securities Company Limited	1
Eternal Pearl Securities Limited	1
Ernst & Young Corporate Finance Limited	1
Emperor Capital Limited	1
E*Trade Securities Co. Ltd	1
CSC Asia Limited	1
Chun Yick Securities Limited	1
Chow Sang Sang Securities Limited	1
China Insurance Group Securities Limited	1
Cheer Union Securities Limited	1
Capital Friend Securities Limited	1
Brighton Securities (HK) Limited	1
BOC International Holding Limited	1
Berich Brokerage Limited	1
Ample Capital Limited	1
Alta Finance Limited	1

3.D Industry Expert Underwriters

Sector Electronic, Electrical Equip.
Oriental Patron Asia Limited
First Shanghai Capital Limited
CSC Securities (HK) Limited
Guotai Junan Securities (HK) Limited
DBS Asia Capital Limited

Sector General Retailers
Sun Hung Kai International Limited
First Shanghai Capital Limited
DBS Asia Capital Limited
Dao Heng Securities Limited
Tai Fook Capital Limited

Sector Leisure Goods
First Shanghai Capital Limited
Oriental Patron Asia Limited
Kingsway Sw Securities Limited
JS Cresvale International Limited
BOCI Asia Limited

Sector Household Goods
Kingston Securities Limited
SBI E2-Capital Securities Limited
Kingsway Sw Securities Limited
Kim Eng Securities (HK) Limited
First Shanghai Capital Limited

Sector Mobile Telecommunications
Morgan Stanley Dean Witter Asia Limited
China International Capital Corporation (HK) Limited
Goldman Sachs (Asia) L.L.C.

Sector Software & Computer Services
Core Pacific - Yamaichi International (HK) Limited
First Shanghai Capital Limited
Celestial Capital Limited
CSC Securities (HK) Limited
Vickers Ballas Capital Limited

Sector General Industrials
Sun Hung Kai International Limited
Kingston Securities Limited
Get Nice Investment Limited
First Shanghai Capital Limited
CAF Securities Company Limited

Sector Personal Goods
Tai Fook Capital Limited
Guotai Junan Securities (HK) Limited
Sun Hung Kai International Limited
Kingston Securities Limited
South China Capital Limited

Sector Technology Hardware & Equip.
Kingsway Sw Securities Limited
Guotai Junan Securities (HK) Limited
First Shanghai Capital Limited
DBS Asia Capital Limited
CSC Securities (HK) Limited

Sector General Financial
Kingsway Sw Securities Limited
Tai Fook Capital Limited
JS Cresvale International Limited
Guotai Junan Securities (HK) Limited
BOCI Asia Limited

Sector Real Estate
Watterson Asia Limited
Morgan Stanley Dean Witter Asia Limited
HSBC Investment Bank Asia Limited
Tanrich Securities Company Limited
Tai Fook Capital Limited

Sector Travel & Leisure
Kingston Securities Limited
Yu Ming Investment Management Limited
Luen Fat Securities Company Limited
JS Cresvale International Limited
CSC Securities (HK) Limited

Sector Industrial Metals
Morgan Stanley Dean Witter Asia Limited
China International Capital Corporation (HK) Limited
TIS Taiwan International Securities (HK) Limited
Taiwan Securities (HK) Company Limited
Tai Fook Capital Limited

Sector Pharmaceuticals, Biotechnology
Guotai Junan Securities (HK) Limited
Kingsway Sw Securities Limited
First Shanghai Capital Limited
Core Pacific - Yamaichi International (HK) Limited
Polaris Securities (HK) Limited

Sector Construction & Materials
Kingston Securities Limited
First Shanghai Capital Limited
Oriental Patron Asia Limited
Guotai Junan Securities (HK) Limited
CSC Securities (HK) Limited

Sector Industrial Transportation
ICEA Capital Limited
BNP Prime Peregrine
South China Capital Limited
Oriental Patron Asia Limited
Morgan Stanley Dean Witter Asia Limited

Sector Oil Equipment & Services
Guotai Junan Securities (HK) Limited
Tai Fook Capital Limited
South China Capital Limited
Partners Capital International Limited
ICEA Capital Limited

Sector Food & Drug Retailers
BNP Prime Peregrine
pacific foundation securities limited
Wintec Securities Limited
UOB Asia (HK) Limited
Uni-Alpha Securities Limited

Sector Support Services
Kingsway Sw Securities Limited
SBI E2-Capital Securities Limited
CSC Securities (HK) Limited
Core Pacific - Yamaichi Capital Limited
BNP Prime Peregrine

Sector Healthcare Equipment, Services
Sun Hung Kai International Limited
ICEA Capital Limited
First Shanghai Capital Limited
Celestial Capital Limited
CEF Capital Limited

Sector Industrial Engineering
SBI E2-Capital Securities Limited
Sun Hung Kai International Limited
Tai Fook Capital Limited
Oriental Patron Asia Limited
Kingsway Sw Securities Limited

Sector Automobiles & Parts
The Bank of East Asia, Limited
Partners Capital International Limited
Kingsway Sw Securities Limited
Guotai Junan Securities (HK) Limited
First Shanghai Capital Limited

Sector Banks
Goldman Sachs (Asia) L.L.C.
HSBC Investment Bank Asia Limited
BOCI Asia Limited
UBS Warburgh
TingKong-RexCapital Securities International Limited

Sector Media
Tai Fook Capital Limited
First Shanghai Capital Limited
Sun Hung Kai International Limited
Kingsway Sw Securities Limited
CEF Capital Limited

Sector Chemicals
Sun Hung Kai International Limited
Kingston Securities Limited
First Shanghai Capital Limited
Core Pacific - Yamaichi International (HK) Limited
Yuanta Securities (HK) Company Limited

Sector Food Producers
Sun Hung Kai International Limited
Guotai Junan Securities (HK) Limited
Tai Fook Capital Limited
First Shanghai Capital Limited
Core Pacific - Yamaichi International (HK) Limited

Sector Equity Investment Instruments
Upbest Securities Company Limited
TIS Taiwan International Securities (HK) Limited
Shenyin Wanguo Capital (HK) Limited
Kingston Securities Limited
First Shanghai Capital Limited

Sector Mining
Merrill Lynch Far East Limited
Deutsche Bank AG, Hong Kong Branch
China International Capital Corporation (HK) Limited
China Everbright Securities (HK) Limited

Sector Forestry & Paper
VC CEF Capital Limited
Tai Fook Capital Limited
Sinopac Securities (Asia) Limited
Guotai Junan Securities (HK) Limited
GC Securities Limited

Sector Beverages
SBI E2-Capital Securities Limited
Pacific Foundation Securities Limited
Guotai Junan Securities (HK) Limited
First Shanghai Capital Limited
CAF Securities Company Limited

Sector Nonlife Insurance
Ka Wah Capital Limited
BNP Prime Peregrine
Worldsec Corporate Finance Limited
Shenyin Wanguo Capital (HK) Limited
Nomura International (HK) Limited

Sector Life Insurance
Morgan Stanley Dean Witter Asia Limited
HSBC Investment Bank Asia Limited
Goldman Sachs (Asia) L.L.C.
Deutsche Bank AG, Hong Kong Branch
Credit Suisse First Boston (HK) Limited

Sector Fixed Line Telecommunications
DBS Asia Capital Limited
China International Capital Corporation (HK) Limited
Wocom Securities Limited
Whole Win Securities Limited
Vermont Securities Company Limited

Sector Electricity
Morgan Stanley Dean Witter Asia Limited
Merrill Lynch Far East Limited
China Merchant Securities (HK) Co. Limited
BOCI Asia Limited

Sector Oil & Gas Producers
China International Capital Corporation (HK) Limited
BOCI Asia Limited
Worldsec Corporate Finance Limited
Tai Fook Capital Limited
Morgan Stanley Dean Witter Asia Limited

Chapter 4
Study on IPO-related Puzzles from the Perspective of Global Games

4.1 Introduction

The research on IPO-related puzzles is extensive. Many theoretical explanations are proposed for these puzzles, including information asymmetry (Michaely and Shaw, 1994; Sherman and Titman, 2002), investors' sentiment (Ritter, 1984; Barberis and Thaler, 2003), and legal risk (Tinic, 1988; Drake and Vestsuypens, 1993). Yet the risk of failure of the IPO caused by an insufficient number of investors' participation in the offering, related to the coordination problem, has not yet been well discussed. It also comes as surprise that the IPO process has not been considered explicitly from the perspective of the coordination problem. In this chapter, we provide a model from the perspective of coordination problem. This research starts from the concerns on the selling method and issuers' pricing strategy for the IPO shares.

In general, people use the auction and the bookbuilding methods in the IPO process. Sherman's (2005) survey of 44 countries shows that issuers choose to use the bookbuilding more frequently than to use the auction method. The bookbuilding method is the preferred choice in most of the IPO cases. Many financial markets in the world have used the auction method for going-public firms; however, the auction

method was not able to survive for long. Documented by Kutsuna and Smith (2004), the Japanese market demonstrates the change over between two selling methods. The discriminatory auction method of issuing shares has been the sole required selling method since 1989 in Japan. Since 1997, in which year the bookbuilding method was introduced as an alternative method, almost all issuers have chosen bookbuilding. However, the auction method is usually believed to be the optimal way of selling goods and assets, and the bookbuilding method is widely perceived to be very expensive. Up till now, the comparison on the issuers' proceeds between these two selling methods has not yet been performed in a theoretical framework.

Meanwhile, underpricing of IPO shares has been documented worldwide. During the period from 1990 to 1998, the underpricing of IPO shares caused a $27 billion loss for the issuers in the U.S. market (Loughran and Ritter, 2002). Yet no consensus has yet been reached among scholars on the issue of the underpricing puzzle. In addition, the relationship between the underpricing and the quality of IPO shares is not clear. The signalling model (Jegadeesh et al., 1993) predicts that the underpricing level is negatively related with the quality of equity, while empirical studies (Garfinkel, 1993; Jain and Kini, 1994; Espenlaub and Tonks, 1998) show that there is no monotonic relationship between underpricing and the quality of asset.

In this chapter, we propose a model from the perspective of a coordination problem. In the framework of global games, we aim to explore the difference of the two offering methods and the underpricing puzzle regarding the coordination

problem. By presenting the model of global games, this chapter sheds light on the following questions. First, is there significant difference between the bookbuilding method and the auction method, regarding both the issuers' proceeds and the offering prices? Second, why are the IPO shares mispriced and what is the relationship between the underpricing level and the quality of IPO shares? From the perspective of a coordination problem, we suggest that the mispricing of IPO shares is the result of issuers' strategies. The model implies that the relationship between underpricing level and the quality of equity is non-monotone. Further to the auction and bookbuilding methods, we suggest that the two offering methods are essentially indifferent for the issuers' proceeds in the noise vanishing market conditions, and the auction method can be better in the noisy market. We believe that rather than maximising the proceeds in the offering, issuers choose bookbuilding method for other reasons, such as introducing favorable investors, maintaining after-market liquidity, and providing price support.

The following sections are organised as follows. After the literature review in Section 4.2, we describe the model in Section 4.3, and discuss the model in Section 4.4. Conclusions are presented in Section 4.5.

4.2 Literature Review

It seems that the auction method fails in the competition with the bookbuilding method for IPOs. The survey by Jagannathan and Sherman (2006) shows that in

IPO cases auctions have been implemented in more than 20 countries in the past and have been used for all sizes of offerings. However, as alternative methods are introduced, the auction method fades out in the IPO business. For example, Italy first introduced the auction method in the early 1980s and then abandoned it in 1986. The bookbuilding method was introduced into Italy in 1992 and then came to dominate the market. The survey also suggests that the variation in participation is a major problem for the auction method. Jagannathan and Sherman argue that there is a trade-off between participation levels and auctions. Too much attention to an offering may lead to the "winner's curse" (when winners are paying more than a fair price) or a free riding problem and ultimately a mispricing of the IPO shares, while too little attention makes the IPO fail. Under the bookbuilding method, however, the underwriter can be the gatekeeper, controlling the number of investors and the type of entrants.

Logue et al. (2002) provide some detailed evidence on what underwriters can do during the IPO process. They believe that the underwriting business is a series of related decisions regarding the offering price and offering strategy. Knowing the underwriting service history, underwriters are able to distinguish different type of investors. As Sherman (2005) concludes, the choice between auction and bookbuilding methods does not solely depend on the underpricing level and other parameters about the IPO performance. People do agree that the bookbuilding method now dominates

the IPO market; however, no agreement has been reached on the reasons why it is the case.

Nevertheless, some people do care about performance of IPOs regarding to the choice between the two selling methods. Pukthuanthong et al. (2005) investigate a data sample from 1999 to 2004 in the U.S. market. They find that the auction method leads to lower underwriter spreads (underwriting fee), less underpricing and a greater trading turnover, while IPOs using bookbuilding are always followed by positive post-IPO analyst coverage. The bookbuilding method may in some way be problematic in pricing the IPO shares, given the long-term underperformance associated with the bookbuilding method. Following the comparison, they argued that bookbuilding IPOs has been over used at the moment. Derrien and Womack (2003) investigate French IPOs during 1992 to 1998 and find that auctions were better at incorporating market condition information into the IPO price and thus produces a lower underpricing level and lower variance of underpricing. However, Kutsuna and Smith (2004) document the evidence from Japan and suggest that the aggregate costs of bookbuilding and auction are similar. Moreover, the bookbuilding system in Japan enables more accurate valuation of firms.

The seemingly conflicting evidence suggests that the advantage of the bookbuilding method is not dominant regarding the performance and the issuers' proceeds. Issues' decision on the selling method can be based on some other considerations, such as the allocation of shares to target investors (Brenan and Franks, 1997;

Stoughton and Zechne, 1998), to increase the after-market liquidity (Booth and Chua, 1996), and price stabilisation activities (Chowdhry and Nanda, 1996; Ellis, Michaely, and O'Hara, 2000).

Given that the mispricing of IPO shares is a widely accepted phenomenon, it is curious to know the relationship between the underpricing level and the quality of IPO shares. Although it is of great theoretical and practical importance to investigate this relationship, the relevant direct evidence is rare in the existing literature. Investigation on this relationship is quite difficult for the following two reasons. First, the quality of asset is difficult to measure. Generally researchers use some proxies of the quality of asset in their investigations, including the sales of the firm, the proportion of insider trading, aftermarket performance, etc. However, none of those proxies is able to represent the quality of equity directly. A comprehensive measure of the quality of equity has not yet been established. Second, most research focus on the existence of linear relationship, ignoring the non-linear relationship between the underpricing and the proxies of quality of equity. Considering the widely used Ordinary Least Square (OLS) analysis, the ignorance of the non-linear relationship is partly due to the insufficient analysis technique on the non-linear relationship. As a result, the non-monotonic relationship between the underpricing and the quality of equity has been long overlooked and the direct evidence is insufficient regarding this non-monotone relationship. We present some indirect empirical findings in the literature below.

Jain and Kini (1994) investigate the post-issue performance of the IPO firms, using the sample of 682 IPO firms in the U.S. market. In this research, the authors use the post-issue performance (the selling and earning in the three years after IPO) as the proxies for the quality of IPO shares. By splitting the sample into two groups by median underpricing level, Jain and Kini show that there is no monotonic relationship between the post-issue performance and the level of underpricing of IPO shares.

Garfinkel (1993) tests the relationship among the IPO underpricing, the insider selling volume and the subsequent equity offering, using the sample of 549 IPOs from 1980 to 1983 in the U.S. market. The author considers the insider selling volume and the subsequent equity offering as the proxies of the quality of equity. The result of the research shows the relationship between the underpricing level and the quality of equity. After controlling for other variables, the result shows that there is no monotonic relationship between the underpricing level and the likelihood of reissue and the announcement of a seasoned offering. In addition, there is no monotonic relationship between the underpricing level and insider trading volume. This result is consistent with Espenlaub and Tonks' (1998) finding that there is no monotonic relationship between the underpricing level and the quality of equity. Using the normalised capitalisation ($\ln(cap)$) of IPOs as a proxy, we can also see the non-monotone relationship from the IPO data from the Hong Kong market. (Figure 4.1)[28]

[28] Source: the Hong Kong Exchange and Clearing Limited (http://www.hkex.com.hk) and Datastream. The bold line is depicted following the model in this chapter.

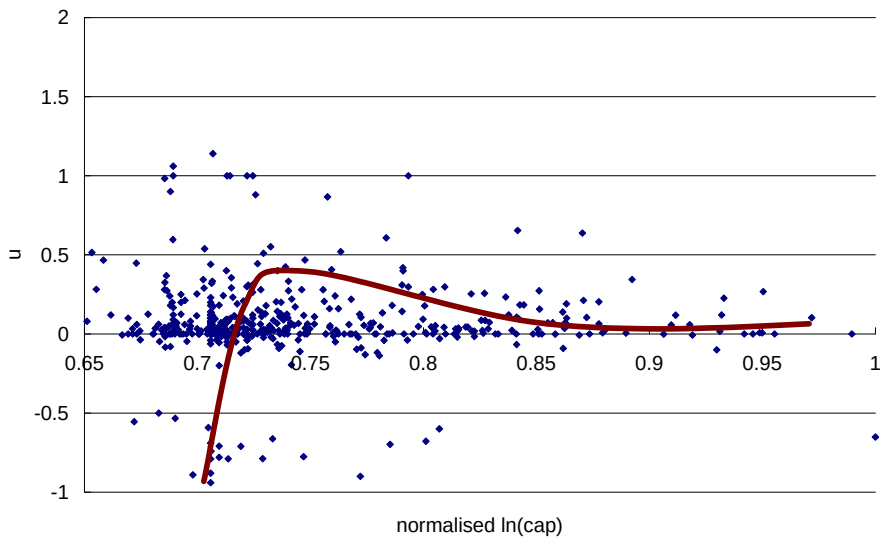

Figure 4.1: The relationship betwen u and normalised capitalisation in the Hong Kong market.

Although it seems that there is no monotone relationship, this non-monotonic relationship remains. In this chapter we perform an analysis from the perspective of coordination problem in the IPO process, in order to discover this non-monotone relationship between the choice of selling methods and the performance of IPO shares (quality of the investment project).

4.3 The global game and the IPO process

4.3.1 The global game

The idea of global games is due to Carlsson and van Damme (1993) and was further developed by Morris and Shin (2002), Frankel et al. (2003), and Heidhues and Melis-

sas (2006) among others. The essential assumption of the global game theory is that of the incomplete information. Within a global game, each player observes the signals, with some noise, and makes his choice within his action sets. To illustrate the purpose of global game theory, and the importance of the assumption of incomplete information, let us consider start with Carlsson and van Damme's 2×2 games.

	a_2	b_2
a_1	θ,θ	θ-1,0
b_1	0,θ-1	0,0

Figure 4.2: Payoff structure of the global game sample (2×2)

The two players' payoff structure is shown in Figure 4.2. The variable θ represents the fundamental (true) value of an investment project and we assume θ is known to both players. In the payoff structure, the actions a_1 and a_2 stand for "invest", while the actions b_1 and b_2 stand for "not invest". Then for $\theta \geq 1$ each player has a dominant strategy to invest, (a_1, a_2); for $\theta \leq 0$ each player has a dominant strategy not to invest, (b_1, b_2). If θ lies between 0 and 1, there are two Nash equilibria in pure strategies: both invest and both not invest.

In the case of m players, let $u(1, n, \theta)$ denote payoff for the player who chooses action 1 (invest) which depends on the underlying fundamental θ and the fraction of agents n who invest too. Then the expected payoff::

$$n\theta + (1 - n)(\theta - 1) = \theta + n - 1$$

is non-negative if sufficient large fraction of agents invest, that is if, and only if:

$$n \geq 1 - \theta.$$

It is straight forward to relate this to the IPO game. There are two periods 0 and 1. There is a continuum of risk neutral investors of measure 1 indexed by $i \in [0, 1]$ who in period 0 participate in primary IPO issuing. The value of the project depends on the underlying state θ which is now random and uncertain at the beginning. The prior of random variable θ is assumed to be normally distributed with mean 1 and precision $\alpha = \frac{1}{\sigma_1^2}$ where σ_1^2 is a variance; $\theta \sim N(1, \frac{1}{\alpha})$

The financing of the project goes through buying a shares where each investor is allowed to buy one share. All decision are made at $t = 0$. The project will succeed yielding positive *ex ante* payoff $E(\theta) - c$, if sufficiently large number of agents decide to buy shares. Otherwise it will fail yielding payoff $-c$, where $0 < c < 1$ is a cost of investment (price of one share).

Denote by n the proportion of investors who buy the shares. Corresponding payoff for investor i provided the investor buys the share is given by:

$$u_i = \begin{cases} 1 - c & n \geq 1 - \theta \\ -c & n < 1 - \theta \end{cases} \tag{4.1}$$

In the above game the actions are strategic complements since it payoffs for player i to invest if and only if the project is successful and in turn, the project is successful if and only if sufficiently large fraction of other investors invest. Also

the game experiences positive externalities since the payoff is increasing function in actions of others.

Global game theory has been applied to describe various economic phenomena, including debt pricing problems, currency crises and bank runs (Morris and Shin, 2002). In this research we take the IPO process as a coordination problem for the following two reasons. First, in the real world, a project cannot start without sufficient investment. Insufficient funds lead to failure in initialising an investment project. Second, investors' decisions do rely on others' decisions. A profitable project may fail to fund itself because of insufficient number of investors participating in IPO. In this chapter we will implement global game theory with regard to the IPO process, to explore the optimal strategies of different players in the game.

4.3.2 The IPO process

In the model, we suggest the basic problem that underwriters need to solve is the coordination problem in the IPO process. The investor can only make profit by investing in IPO shares if the project is successful, and the project can be successful if, and only if, there is a sufficient number of investors investing. If the process of the offering is not successful and the fund-raising target cannot be achieved, the issuer may withdraw the offering and the investment fails.

In this research, we consider three subjects in the IPO game. The first one is the underwriter. Underwriters are the only fully informed player in the game and their

only aim is to achieve the best probability of success of the IPO. Considering their monopolistic position in the offering, underwriters are able to decide the proportion of shares issued in the primary market and the secondary market by incorporating information about investors' perceptions of the IPO shares in both markets.

The second subject is that of the issuer. Issuers want to raise enough funds for the project in the IPOs, and their aim is to raise as much funding as possible. This requires the underwriter to achieve the highest possible selling prices in both markets, provided the IPO is successful.

There are two types of contracts between issuer and underwriter: the best-effort contract and the commitment contract. We concentrate on the commitment contract in this research as it is the most commonly used contract type. Under the commitment contract, underwriters suffer the loss if the IPO fails. As a result, underwriters do their best by collecting information to avoid failure.

The third subject is that of the institutional investors. The institutional investors can submit their bids to underwriters in the roadshow and the underwriters distinguish them from other ordinary investors. Cornelli and Goldreich (2001, 2003) documented that underwriters favour some institutional investors that are frequently involved in IPOs and thus place favorable IPO shares to them. Benveniste and Spindt (1989) suggest that investors supply their private information about the IPO shares to the underwriters in return. In addition, it is reasonable to believe that those institutional investors that are favoured in the allocation of shares are willing to hold

the shares in the first few trading days in the secondary market as a return to the underwriters.

We assume the IPO game is in a game of imperfect (noisy) information. All investors receive a noisy signal regarding the value of the project. Yet investors in the first stage of selling can only observe θ with some noise. The investors in the second stage collect information about θ by observing the price in the first stage. Only the underwriters know the realisation of θ in the game. Based on their own perception of signals, players make decisions independently.

In the model, we assume the auction method as one stage selling. The issuer sells out all the shares in the auction and thus do not participate in the secondary market. On the contrary, the model consider the bookbuilding method completely finished only after when the holding period of institutional investors expires. Issuers sell a fraction of the shares in primary market and keep the rest of the shares for secondary market selling. Normally this holding period lasts from 1 to 3 days after when the secondary market is launched. As a result, the first few days in the secondary market is the second selling stage in our model. Figure 4.3 illustrates the two selling stages.

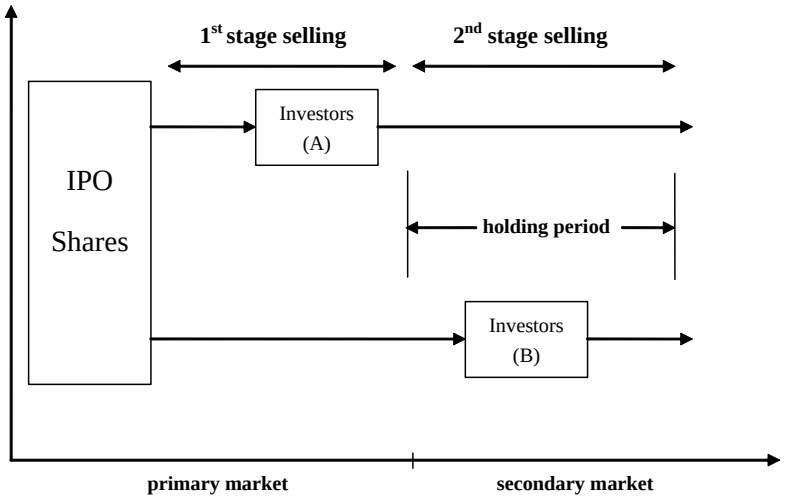

Figure 4.3: Bookbuilding method: a two-stage selling model

4.3.3 The coordination problem

The coordination problem is critical for underwriters in IPO, as the major task for the underwriters is to solve the coordination problem during the offering from the investors' perspective.

Stories such as bank runs are quite similar to the IPO game. In a bank run, it is claimed that because of ambiguous information about the bank, the distressed borrowers are facing the same problems as the investors face in the IPO game. Morris and Shin (2002) discuss the bank run problem as a coordination problem. In addition, Dasgupta (2001) argues that this is also true for foreign direct investment (FDI) if the investors are facing similarly ambiguous information on the state of the national economy and the risk involved.

In IPO, the investors may acquire knowledge about the underlying project from the prospectus released by the issuers and analysts' reports about the project; however, investors may face two problems in collecting relevant information. On one hand, the information is costly, as most of the investors need to pay for the analysts' reports. On the other hand, considering the issuers and underwriters are trying to promote the offerings by providing optimal information about the investment project, real information about the investment is somewhat vague. If the IPO fails to raise enough funds, the shares in investors' accounts can be valueless.

Beside fundamental analysis, we find that there is another channel to transmit information about the funding situation of the project. At the end of the primary market, the offering price becomes public information. The trading price in primary market could be an important signal of the investors' information about the value of the investment in primary market. The investors in the secondary market rely on the offering prices from the primary market to adjust their information set about the value of IPO shares.

4.4 The Model

Below we model two offering methods: auction and bookbuilding. In the model, the auction method is a one-stage selling method, mainly discussed as the benchmark model, and bookbuilding is regarded as a two-stage selling method.

4.4.1 Auction: the benchmark model

In the auction method, once the shares have been sold out, the selling process ends. We seek for an equilibrium here following Morris and Shin (1997). We assume that the prior distribution of θ is a common knowledge. In addition we assume that each investor receives private noisy signal about the true value θ in the form:

$$x_i = \theta + \varepsilon_i, \tag{4.2}$$

where ε_i is distributed normally with mean 0 and precision $\beta = \frac{1}{\sigma_2^2}$ and independently among investors, that is for $i \neq j$, ε_i and ε_j are independent; $\varepsilon_i \sim N(0, \frac{1}{\beta})$. Given his own signal x_i, ith investor will choose one of two actions: invest $a = 1$ or to not invest $a = 0$ in order to maximize his expected payoff, that is:

$$a(x) = \arg\max_a E[u(a, n, \theta)|x]. \tag{4.3}$$

Since $x|\theta \sim N(\theta, \frac{1}{\beta})$ the fraction of investors who buy the shares is given by:

$$n(\theta) = \int a(x)\sqrt{\beta}\phi(\sqrt{\alpha}(x - \theta))dx. \tag{4.4}$$

where ϕ stands for standard normal probability distribution.

In a monotone or *threshold* equilibrium there is a threshold x^* such that for any realization of his own signal x the investor will buy the share $(a(x) = 1)$ if and only if $x \geq x^*$. By inspecting (4.4) we see that $n(\theta)$ is increasing in θ so that there exists also a threshold θ^* such that the project is successful if and only if $\theta \geq \theta^*$. The pair of switching values (x^*, θ^*) characterise the equilibrium.

From (4.4), it follows that the fraction of agents who receive the signal $x \geq x^*$ is given by:

$$n(\theta) = \int_{x^*}^{\infty} \sqrt{\beta}\phi(\sqrt{\beta}(x-\theta))dx = 1 - \Phi(\sqrt{\beta}(x^* - \theta)) \tag{4.5}$$

where Φ stands for standard standard normal probability function. Since $n(\theta)$ is increasing in θ and project is successful if and only if $\theta \geq \theta^*$ it follows that θ^* is unique solution of the equation $n(\theta^*) = 1 - \theta^*$:

$$\Phi(\sqrt{\beta}(x^* - \theta^*)) = \theta^* \tag{4.6}$$

On the other hand given the project is successful the expected payoff of an investor given his signal x is given by:

$$E(U) = P(\theta \geq \theta^*|x)(1-c) - (1 - P(\theta \geq \theta^*|x))c = P(\theta \geq \theta^*|x) - c.$$

At switching point x^* the marginal investor is indifferent between investing and not investing and his expected payoff is zero what implies:

$$P(\theta \geq \theta^*|x^*) = c \tag{4.7}$$

Equations (4.6) and (4.7) define an equilibrium where the price of share c is set for marginal investor. In order to proceed we have to find distribution of θ conditional on x. By Bayes rule conditional on x, θ is normally distributed with mean:

$$\xi = \frac{\alpha + \beta x}{\alpha + \beta}$$

and the precision

$$\frac{1}{\alpha + \beta}.$$

Now in equilibrium equation (4.7) can be written as

$$1 - \Phi\left(\sqrt{\alpha+\beta}\left(\theta^* - \frac{\alpha+\beta x}{\alpha+\beta}\right)\right) = c$$

from which we can express x^* as

$$x^* = \frac{\alpha+\beta}{\beta}\theta^* - \frac{\alpha}{\beta} - \frac{\sqrt{\alpha+\beta}}{\beta}\Phi^{-1}(1-c).$$

Substituting x^* in (4.6) we get the equation for the equilibrium value of θ^*:

$$F(\theta^*) \equiv \theta^* - \Phi\left(\frac{\alpha}{\sqrt{\beta}}(\theta^*-1) - \sqrt{1+\frac{\alpha}{\beta}}\Phi^{-1}(1-c)\right) = 0. \tag{4.8}$$

Because $F(\theta^*)$ is continuous going from $-\infty$ to $+\infty$ the existence of equilibria is guaranteed. Taking the first derivative of $F(\theta^*)$ in respect to θ^* it is easy to show that the equilibrium will be unique if $\frac{\alpha}{\sqrt{\beta}} < \sqrt{2\pi}$ as in that case $F(\theta^*)$ is monotonic in θ^*.

In real financial markets, investors receive information about the investment project along with some noise. As we cannot ignore the noise, the equilibrium condition should be:

$$\Phi\left(\frac{\alpha}{\sqrt{\beta}}(\theta^*-1) - \sqrt{1+\frac{\alpha}{\beta}}\Phi^{-1}(1-c)\right) = \theta^* \tag{4.9}$$

Because investors are risk neutral, the second condition for the equilibrium is:

$$\Pr(\theta > \theta^* | x^*) = c. \tag{4.10}$$

Provided that $\frac{\alpha}{\sqrt{\beta}} < \sqrt{2\pi}$ (it is always the case if the prior is diffuse enough relative to β), there is monotonic relationship between c and θ^*. By considering the

two conditions (4.9,4.10) for the equilibrium, we can solve:

$$c = \Phi\left(\sqrt{\frac{\beta}{\alpha+\beta}}\Phi^{-1}(\theta^*) - \frac{\alpha}{\sqrt{\alpha+\beta}}(\theta^* - 1))\right) \tag{4.11}$$

In the noise vanishing equilibrium when there is no noise in private signals ($\beta \to \infty$) from equation (4.11), it follows $c = \theta^*$. The result suggest that the offering price must be at the same level of the quality of the IPO shares.

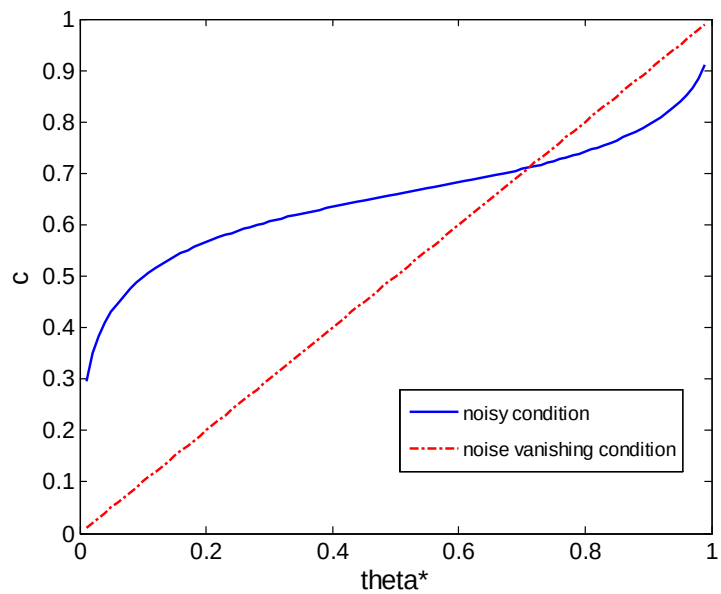

Figure 4.4: The offering price c under different market conditions.

Figure 4.4 illustrate the offering price in the equilibrium under the noisy vanishing condition and noisy condition[29]. It is clear the offering prices vary in different market conditions regarding the quality of IPO shares..The offering price can be higher in the noisy market than in the noisy vanishing market when θ^* is at a lower

[29] In the setting, we assign the parameters as following: $\alpha = 1$ and $\beta = 0.5$.

level. And the offering price is lower when θ^* is at the higher level. The result suggests that the quality of IPO shares is not so clearly reflected in the offering price in a noisy market as in a noise-vanishing market.

As the trading price of IPO shares is equal to the true value θ^* at the end of the offering, the mispricing level can be defined as $u = \frac{\theta^* - c}{c}$. The result shows that the IPO shares are underpriced (the mispricing u is positive) when θ^* is high, while they are overpriced (the mispricing u is negative) when θ^* is low. There is no mispricing at the extreme cases ($\theta^* = 0$ and $\theta^* = 1$), when the offering price c are 0 and 1 respectively.

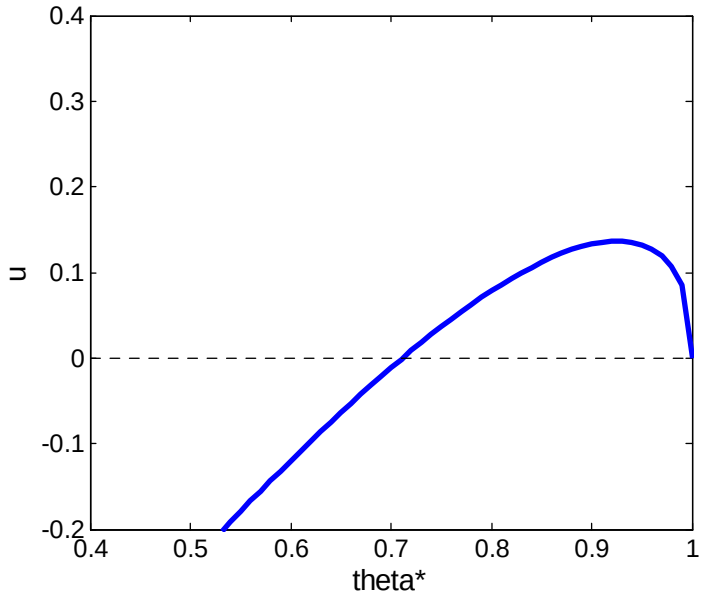

Figure 4.5: The relationship between the mispricing level u and the value of IPO shares.

Figure 4.5 shows the result of the mispricing level across θ^* in the equilibrium. The model implies that underpricing is related to the higher quality of IPO shares while overpricing is signalling for a lower quality. Contrary to existing theoretical literature, in the underpricing part the model implies that the underpricing level is non-monotonically related to the quality of equity θ^*. Before some value of θ^*, the underpricing u increases with θ^* while decreases with θ^* after the critical point.

4.4.2 Bookbuilding: a two-stage selling model

In the bookbuilding method, there are two stages: the primary market (first stage) and the first few days in the secondary market (second stage). We assume that in the bookbuilding method investors participate either in the first stage or in the second stage.

The assumptions for the game are as follows. There are two periods 1 and 2. Risk neutral investors are divided into two groups. The investors in the first group $i \in [0, \lambda]$ choose their actions in period 1, and investors in the second group $i \in (\lambda, 1]$ choose their actions in period 2. The shares are priced at c_1 and c_2 in period 1 and 2 respectively. As before the financial status of the investment project is summarised by θ and its common prior is $\theta \sim N(0, \frac{1}{\alpha})$.

The utility function for investors in both periods are as follows, where n denotes the total number of investors that make the investment decisions in both stages:

$$u(I_1, n, \theta) = \begin{cases} 1 - c_1 & n \geq 1 - \theta \\ -c_1 & \text{otherwise} \end{cases}$$

$$u(I_2, n, \theta) = \begin{cases} 1 - c_2 & n \geq 1 - \theta \\ -c_2 & \text{otherwise} \end{cases}$$
$$u(N, n, \theta) = 0$$

I_1, I_2 and N denote the investors who invest now (period 1), investors who invest later (period 2) and those investors who never invest in this IPO.

The information structure is as follows. During the period 1, the investors ($i \in [0, \lambda]$) observe the status of the investment project with idiosyncratic noise. The private signal received by agent i is

$$x_i = \theta + \varepsilon_{xi} \qquad \varepsilon_{xi} \sim N(0, \frac{1}{\beta})$$

In the second period the investor i ($i \in [0, \lambda]$) receives noisy information about the status of the project through two channels. The first one is his own private signal:

$$y_i = c_1 + \varepsilon_{yi} \qquad \varepsilon_{yi} \sim N(0, \frac{1}{\gamma})$$

As the investor observes the price c_1 his second channel is the public signal[30]:

$$c_1 = \theta + \xi_i, \qquad \xi \sim N(0, \frac{1}{\alpha})$$

The investors adopt the monotone strategy in this game. This means that the investor ($i \in [0, \lambda]$) will only invest if $x_i \geq x^*$. The investor ($i \in (\lambda, 1]$) will only invest if $y_i \geq y^*$. The project will only succeed if, and only if, $\theta \geq \theta^*$. Performing essentially the same analysis as in the benchmark (one stage selling) model we arrive

[30] Here we assign α, β, and γ for precision of public signal, private signals in period 1, and private signals in period 2 respectively.

at the following equilibrium condition:

$$\lambda\Phi_1 + (1-\lambda)\Phi_2 = 1 - \theta^* \tag{4.12}$$

where

$$\Phi_1 \equiv \Phi[\frac{\alpha}{\sqrt{\beta}}(\theta^* - 1) - \sqrt{1+\frac{\alpha}{\beta}}\Phi^{-1}(1-c_1)]$$
$$\Phi_2 \equiv \Phi[\frac{\alpha}{\sqrt{\gamma}}(\theta^* - c_1) - \sqrt{1+\frac{\alpha}{\gamma}}\Phi^{-1}(1-c_2)].$$

If we look at (4.12) then there are no unique solutions $c_1(\theta^*)$ and $c_2(\theta^*)$ so we have to impose some additional objective like maximizing proceed.

Considering the following problem:

$$\max_{c_1,c_2}[\lambda\Phi_1 c_1 + (1-\lambda)\Phi_2 c_2] \tag{4.13}$$

s.t.

$$\lambda\Phi_1 + (1-\lambda)\Phi_2 = 1 - \theta^* \tag{4.14}$$

and first the noisy vanishing equilibrium ($\beta \to \infty$, $\gamma \to \infty$) in which $\Phi_1 \to 1 - c_1$ and $\Phi_2 \to 1 - c_2$. The equation $\lambda\Phi_1 + (1-\lambda)\Phi_2 = 1 - \theta^*$ has a unique solution $c_1 = c_2 = \theta$.In terms of n_1 and n_2 (numbers of shares sold in stage 1 and 2 respectively), $n_1 = \lambda(1-c_1)$, $n_2 = (1-\lambda)(1-c_2)$, the problem reads

$$\max_{n_1,n_2} n_1(1 - \frac{n_1}{\lambda}) + n_2(1 - \frac{n_2}{1-\lambda})$$

s.t

$$n_1 + n_2 = 1 - \theta^*.$$

From first order conditions we have that

$$n_1 = \frac{\lambda}{1-\lambda} n_2. \tag{4.15}$$

We also know that in equilibrium the equation $\lambda\Phi_1 + (1-\lambda)\Phi_2 = \theta^*$ has unique solutions only in two state of nature $\theta^* = 0$ and $\theta^* = 1$. When $\theta^* = 0$, $c_1 = c_2 = 0$ and when $\theta^* = 1$, $c_1 = c_2 = 1$. These two points coincide with noisy vanishing equilibrium as well. Should we expect that the relation (4.15) holds in noisy equilibrium?

In noisy equilibrium the problem (4.13) yields to the following Lagrangian:.

$$L = \lambda\Phi_1 c_1 + (1-\lambda)\Phi_2 c_2 - \xi\left(\lambda\Phi_1 + (1-\lambda)\Phi_2 - 1 + \theta\right)$$

First order conditions (FOC):

$$\lambda\Phi_1 + \lambda\Phi'_{1,c_1} c_1 + (1-\lambda)\Phi'_{2,c1} c_2 - \xi\lambda\Phi'_{1,c_1} - \xi(1-\lambda)\Phi'_{2,c_1} = 0 \tag{4.16}$$

$$\Phi_2 + \Phi'_{2,c_2} c_2 - \xi\Phi'_{2,c_2} = 0 \tag{4.17}$$

But from (4.14)we have:

$$(1-\lambda)\Phi'_{2,c1} = -\lambda\Phi'_{1,c_1}$$

$$(1-\lambda)\Phi'_{2,c2} = 0$$

what after substituting into FOC yields to:

$$(\Phi_1(c_2 - c_1))' = 0$$

$$\Phi_2 = 0$$

so that $n_2 = 0$ and (4.14) reduces to $\lambda\Phi_1 = 1 - \theta$; we are in the case of one stage selling. Also we should note that there is no way to endogenously derive c_2 (although formal solution of $\Phi_2 = 0$ is $c_2 = 1$ but in fact it is revealed value of the project, i.e. $c_2 = \theta$). The conclusion is with the constraint (4.12) the optimal way of selling is one stage selling.

However we know that for many reasons underwriter wants to sell in two stages as providing liquidity, price support, etc. In order to be able to perform two stage selling the underwriter has to impose additional constraints on the numbers of shares sold in each stage. It is easy to show that in that case we can recover the relation (4.15)[31] As we do not consider explicitly the constraints for other reasons in this model, in what follows we choose the pricing strategy by imposing the same share allocation as in the noisy vanishing equilibrium that is:

$$\Phi_1 = \Phi_2$$

Combining this with (4.14) we have in:

$$\Phi_1(c_1) = 1 - \theta$$

$$\Phi_2(c_1, c_2) = 1 - \theta$$

Then we can solve the pricing strategy in the noisy equilibrium:

$$c_1 = \Phi\left(\sqrt{\frac{\beta}{\alpha+\beta}}\Phi^{-1}(\theta^*) - \frac{\alpha}{\sqrt{\alpha+\beta}}(\theta^* - 1))\right) \tag{4.18}$$

[31] The constraints can be chosen to be of the following form $\Phi_1 = \frac{\eta}{\lambda}(1-\theta)$ and $\Phi_2 = \frac{1-\eta}{1-\lambda}(1-\theta)$ with $\eta \leq \lambda$.

$$c_2 = \Phi\left(\sqrt{\frac{\gamma}{\alpha+\gamma}}\Phi^{-1}(\theta^*) - \frac{\alpha}{\sqrt{\alpha+\gamma}}(\theta^* - c_1))\right) \tag{4.19}$$

The prices c_1 and c_2 under different market conditions

As discussed in the equilibrium conditions, the equation $\lambda\Phi_1 + (1-\lambda)\Phi_2 = 1 - \theta^*$ has a unique solution $c_1 = c_2 = \theta$ in noisy vanishing equilibrium. The result implies that the prices at both stages are the same. At this price level, there is always a solution for the equilibrium regarding all $\lambda \in [0, 1]$.

In the noisy condition, we can derive the price from the equilibrium condition by considering the following two scenarios: $\beta \geq \gamma$ and $\beta < \gamma$.

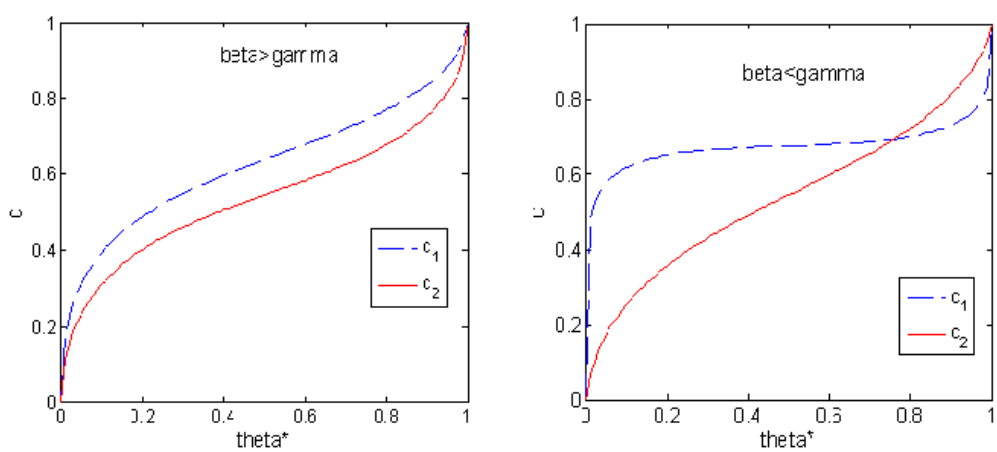

Figure 4.6: The prices c_1 and c_2 under different market conditions

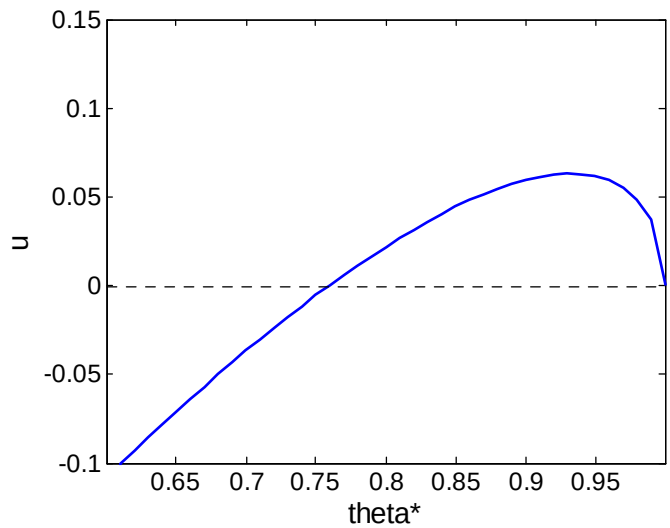

Figure 4.7: The relationship between u and θ^* in two-stage selling.

Figure 4.6 illustrate the c_1 and c_2 in the equilibria under the two scenarios.[32] The figure shows that when the precision in the first stage is higher than in the second stage, it is possible that the offering price is higher than the trading price in the first few days in secondary market.

We define here the mispricing level $u = \frac{c_2 - c_1}{c_1}$. When the precision in the first stage is lower than in the second stage, the shares are underpriced (u is positive) when θ^* is high, and are overpriced (u is negative) when θ^* is low. In general, we consider the investors in secondary market receive more precise information about the value of shares ($\beta < \gamma$). Therefore, the model implies that the underpricing, rather than overpricing, signals for a better quality of IPO shares.

[32] For the equilibrium regarding $\beta \geq \gamma$, we assign the parameters as: $\alpha = 1$, $\beta = 3$ and $\gamma = 2$. For the equilibrium regarding $\beta < \gamma$, we assign the parameters as: $\alpha = 1$, $\beta = 2$ and $\gamma = 3$.

Further to the underpricing level, the model suggests the relationship between underpricing (u) and the quality of IPO shares is non-monotone as shown in Figure 4.7.[33] This implication of the model is consistent with the empirical observations (Jain and Kini, 1994; Garfinkel, 1993; Espenlaub and Tonks, 1998). When using the sales of the IPO firms in the year after going public as the measure of the θ^*, the non-monotone relationship is clear as well. (Figure 4.8)[34]

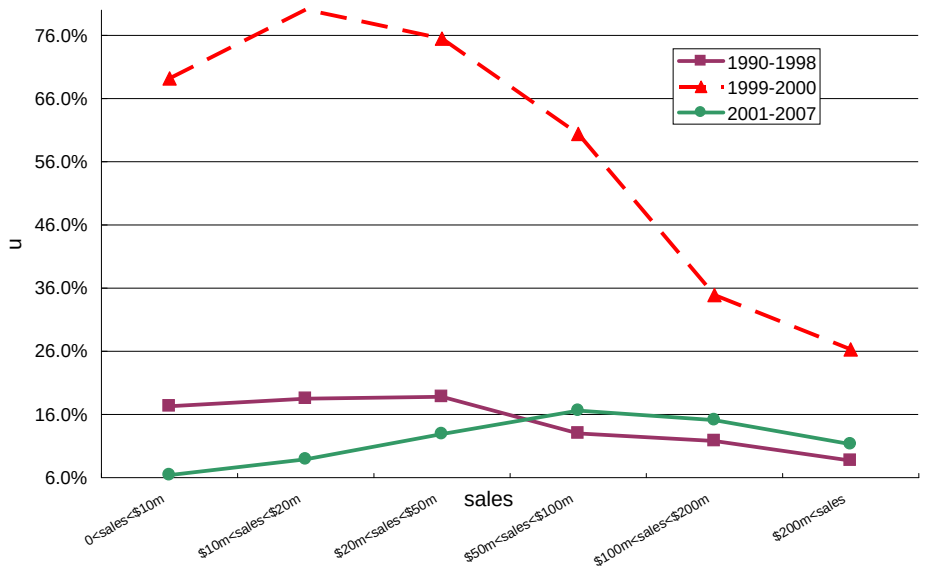

Figure 4.8: Underpricing level and the quality of equity (sales as the signal θ^*).

[33] We assign the parameters as: $\alpha = 1$, $\beta = 1$, and $\gamma = 10$.

[34] Source: Jay Ritter, 2008, "Some factoids about the 2007 IPO market", University of Florida, http://bear.cba.ufl.edu/ritter.

Issuers' choices between auction and bookbuilding

We assume that issuers choose the selling method regarding their proceeds in the offering using different selling methods. To compare the proceeds, it is necessary to discuss the proceeds in the noisy vanishing and noisy market conditions separately.

In the noisy vanishing condition, the proceed of the issuer in the auction is

$$p_a = n \cdot c = (1 - \theta^*)\theta^*.$$

The proceed in the and the bookbuilding is

$$p_b = n_1 c_1 + n_2 c_2 = (1 - \theta^*)\theta^*.$$

Thus the proceeds are the same for the issuers in both selling methods.

Under the noisy condition, we show earlier that in the equilibrium $n_2 = 0$ is the optimal strategy for issuers to maximise their proceeds. When $n_2 = 0$, the two-stage selling turns to one-stage selling. Therefore, we conclude that the auction method is better for issuers regarding the proceeds in the offering in both the noisy and noisy vanishing market conditions. Nevertheless, we consider only the coordination problem in the model. In IPO practice, issuers need to consider other factors, including share allocation to target investors, maintaining liquidity in secondary market and so on. Although the bookbuilding method is not the best choice for maximising proceeds, it allows issuers participate in the secondary market and the bookbuilding method may help issuers to improve the IPO performance in other ways. In the Figure (4.9), we show the issuers' proceeds in one-stage selling and two-stage selling

in the noisy equilibrium.[35] It is worth to mention that proceeds are typically greater in the region of overpricing for lower θ when the effect of adverse selection is much more pronounced.

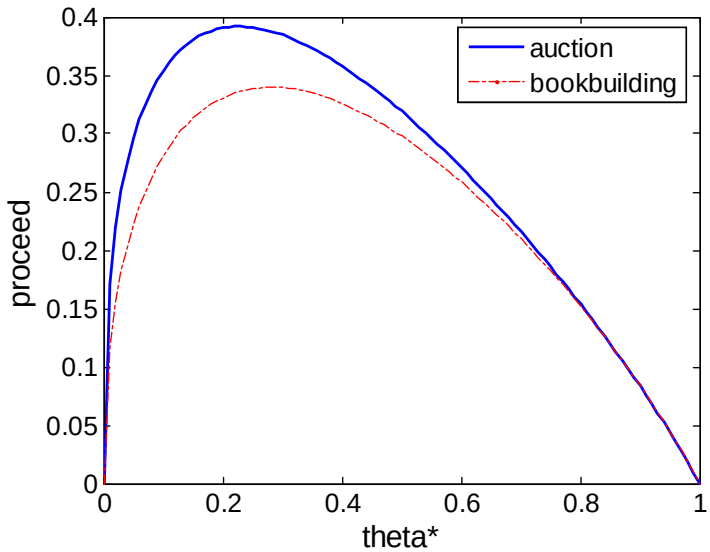

Figure 4.9: Issuers' proceeds in the auction and the bookbuilding methods in the noisy equilibrium.

4.5 Concluding discussion

In this chapter we present a model of global games applied on the coordination problem in the IPO process and issuers' pricing strategy. In the model, we consider the auction as one-stage selling method and the bookbuilding as two-stage selling method.

[35] We assign the parameters as: $\alpha = 1$, $\beta = 1$, $\gamma = 10$ and $\lambda = 0.6$.

The model suggests that there can be overpricing and underpricing in the noisy market conditions, regarding the quality of IPO shares. In both the auction and the bookbuilding method, the underpricing signals the higher quality of the investment project while overpricing of IPO shares signals for lower quality of the investment project. In addition, the relationship between underpricing level and the quality of IPO shares is non-monotone. The model implies that the underpricing increases in the region of lower quality and then decreases in the higher quality region. This finding is consistent with empirical observations.

Further to the issuers' proceeds, the model suggests that the auction method is always the best choice. Nevertheless, the model only considers the coordination problem in the IPO process. Bookbuilding method allows issuers to participate in the secondary market and it is possible that the bookbuilding method is helpful for issuers in other ways, as it was mentioned.

It is noteworthy that the model does not consider the investors' demand side in the secondary market. We plan to incorporate more information from the demand side in future research. Also, one important aspect which can be studied in this framework is the behaviour of "flippers" in the IPO process and their impact on prices and stabilisation efforts of underwriters. In addition, the model can be extended to other applications beyond IPO-related puzzles in the future.

Chapter 5
Conclusion

IPO is essentially the most important step in the life of a firm. Yet with respect to financial studies, IPO-related puzzles have not yet been fully resolved. This thesis focuses on IPO-related puzzles, primarily on the underpricing problems, and provides some new empirical evidence and theoretical explanations for them from the perspective of a coordination problem.

Indeed, academic scholars have carried out profound investigations in this area and have discovered a considerable number of puzzles related to the IPO process, such as underpricing puzzle, and the long-term underperformance puzzle. Among all of these, we selected the underpricing puzzle as the major concern of the thesis for the following reasons. First, the underpricing puzzle is one of the few intrinsic characteristics of the IPO process, and is the most unusual one. It is difficult to imagine that assets can be undervalued by more than 5% in modern financial markets, but it does happen in the IPO process. In fact, IPO shares have been persistently undervalued in the market, which is contrary to expectation given financial practitioners' common sense. For decades, issuers have kept leaving money on the table for the investors in the primary market in IPO practice. Second, the underpricing puzzle is a "real" puzzle. It has been shown to occur by empirical studies in more than 20 financial markets around the world, which also excludes the possibility that the puz-

zle is caused by securities regulations and different accounting standards. Other IPO related puzzles, however, have only been witnessed in a few markets, or in certain periods, and these are arguably caused by particular regulations or temporary events.

This thesis focuses on the IPO underpricing puzzle from both the empirical and theoretical points of view. Rooted in the existing literature, the thesis aims at exploring the following research questions: is the market liquidity important to the underpricing level and the timing of going public? Is it possible that good underwriters are able to eliminate, or at least reduce the underpricing level? For what purpose, do issuers deliberately undervalue the IPO shares in the primary market?

In this brief conclusion we wish to summarise the results found in the research which are presented in Section 5.1, and to propose future research directions around IPO puzzles, in Section 5.2.

5.1 Summary of the Research Project

The research commences with empirical studies on market liquidity. Chapter 2 focuses on the time series properties of the level of underpricing of IPO shares. The regression test reveals strong auto-correlation within the level of underpricing. The evidence from the Hong Kong market suggests the initial selling volume (by capitalisation) is a determinant factor in the relationship. In addition, we find that the relationship between the underpricing level and the clustering of IPOs within different industries is weak in the IPO sample, suggesting the reasons for underpricing

are rather related to the market liquidity than industry-specific risk characteristics. This finding here suggests that market liquidity should be considered as an important driving force for the IPO underpricing puzzle. In addition, it is possible that deliberate undervaluation is an issuers' strategy in order to avoid liquidity risks.

As the offering strategy is mainly decided by underwriters, it is essential to understand the underwriting business and how the underwriting syndicates work. In Chapter 3, we investigate the underwriting network. The aim of the investigation is to explore the relationship between the underwriting business and IPO-related puzzles. We find that in IPO practice, one of the advantages of the top ranked underwriters is their relationship networks with other underwriters and institutional investors. Based on these networks, the underwriters acquire market pricing information and distribute equities to the market. We perform a careful examination of the underwriter syndicate and investigate the relationship of the structure of the syndicate to IPO performance. In addition, the pattern of distribution in the size of syndicates is identified as related to the IPO performance. The research also distinguishes two sub-groups of underwriters using random graph analysis. It is true that the quality of underwriters does not change the price of IPO shares, but the underwriters can be determinant in the choice of pricing strategy. The results presented in Chapter 3 show that the perspective from the underwriters' syndicate is not only interesting, but also necessary to the understanding of IPOs.

In Chapter 4 we explore the reasons why issuers and underwriters deliberately misprice the IPO shares in the primary market in order to decrease the risk of failure caused by insufficient number of investors participation and which method, the auction or the bookbuilding, is better from the perspective of issuer's proceed The research offers an explanation based upon the investors' coordination problem in the IPO process in the framework of global game theory. The research suggests that the relationship between the underpricing level and the quality of shares is non-monotone, and this finding is consistent with the empirical observations .Also the model shows that the auction method is the optimal choice for issuers allowing them to solve coordination problems at greater proceeds. The analysis presented in Chapter 4 shows that in an environment where investors cannot receive precise information, issuers' proceeds in IPOs are greater using the auction method than using the bookbuilding method. It is noteworthy that we only consider coordination problem in the model. The bookbuilding method allows issuers to participate in secondary market and can be helpful for issuers in maintaining liquidity for IPO shares and providing price support.

By studying liquidity, business networks and the coordination problem, the thesis provides unique explanations for the IPO underpricing and other related puzzles, and opens some interesting venues for future IPO research.

5.2 Suggestions for Future Research

Scholars have been aware of the IPO-related puzzles ever since they were first noticed by Ibbotson (1975) and Ritter (1984). Lots of efforts have been made to explain them in both empirical and theoretical studies. Some new theories, such as behavioural finance, are deeply rooted in IPO-related phenomena and exhibit their explanatory power in those puzzles. Yet there is no doubt that these puzzles are still one of the most important and challenging areas for scholars.

With respect to empirical studies, it is still necessary to confirm the other IPO-related puzzles using empirical evidence. For example, empirical evidence about the long-term underperformance puzzle in financial markets outside the U.S. is rare at the moment. The lack of sufficient empirical evidence leaves the possibility that the puzzle could be a result of local regulation and accounting standards, but not a universal phenomenon. In addition, the "book" needs to be carefully examined in the bookbuilding system. Due to the confidentiality of the book information in the bookbuilding methods, only very limited information about the book has been disclosed in the existing literature, which is still insufficient for empirical studies. Underwriters' pricing strategies can only be clearly revealed when the details in the books are made available.

It is also necessary to calibrate underwriters' reputations using a widely-accepted standard. At the moment, the calibration of underwriters' reputations is always based on the underwriters' service history in the local market. However, issuers do also

consider the underwriters' business strength in international financial markets as an important factor. A precise calibration of underwriters' reputations also requires us to monitor any change of reputation over time.

Further to the basic theoretical studies, existing literature focuses on information asymmetry and investors' sentiment, but ignores the other risk factors, such as the coordination risk. We elaborate the framework of the coordination problem in the thesis, but this is only a start and presents preliminary findings. If we could take the investors' risk aversion into the configuration of the game, the outcome would be more reliable. Thus a combination of behavioural finance and coordination problem based considerations is the best way forward for future research.

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