# THE IMPACT OF INSTITUTIONAL FRAMEWORK, INTEREST RATE AND DEMAND ON IPO UNDERPRICING: A THEORETICAL MODEL AND EMPIRICAL TEST

by

Wang Kangmao

Dissertation
for the Degree of Doctor of Business Administration in
Department of Accounting and Finance
Strathclyde Business School, University of Strathclyde

May, 1998

**Abstract**

This dissertation acknowledges that the pricing scheme of initial public offering (IPO) is profoundly affected by the institutional framework within which IPOs are floated. Through the events of filing, red herring and road show, pricing, offering and first day trading, IPO underpricing develops via two stages. The first stage is the change experienced from mean initial filing price $M$ (also known as the red herring price) to final offer price $F$. The second stage is the change from final offer price $F$ to first trading day closing price $T$. The analysis applies the relative change from $M$ to $F$ to define an institutional variable of demand index and it employs the relative change from $F$ to $T$ to illustrate a core definition of underpricing at the second stage which takes place between the primary and secondary market.

Based on the definitions outlined above a comprehensive model is developed; the model incorporates a basic model and an advanced model. The model demonstrates that the issuer selects an optimal offer price based upon investors' optimal demand function. The model establishes propositions that underpricing is increasing functions of market demand, risk free interest rate, investors' absolute risk aversion, aftermarket variance, total shares offered and decreasing functions of expected aftermarket price and offer price. The model also illustrates the roles of road show and underwriting in relation to underpricing.

A cross-section empirical test is conducted on a sample of 531 IPOs issued in the United States between 1988 and 1993 to investigate the relationship between IPO underpricing and relevant institutional and other factors derived in the model. The analysis applies the procedure of market adjustment which is based on Dow Jones Industrial Average (closing) on red herring date, offer date and first trading day. The analysis of the data proves that underpricing is positively correlated with (1) demand index, (2) inverse of total proceeds and (3) the interaction between demand index and inverse of total proceeds. The univariate analysis reveals that higher interest rate is more likely to produce underpriced IPOs. The empirical test also concludes that when the final offer price is above mean initial filing price, the probability is 80 percent for investors to gain an underpriced issue.

## Contents

**Chapter Eight: Conclusions**

## Tables and Figures

### Tables

**Figures**

# Chapter One
# Introduction

## 1.1. Previous Studies on IPO Underpricing and Their Limitations

The phenomenon of initial public offerings (IPOs) underpricing has been well researched. During the past three decades, several hundreds of research studies have been published on the subject. Consistent with the widely cited empirical findings by Ibbotson (1975) which revealed an average underpricing of 11.4 percent (in the period 1960-1969), average IPO underpricing reported by the subsequent studies ranges from 10 to 25 percent. In this dissertation an investigation on more recent IPOs in the United States discloses an average underpricing of 10 percent during the period 1988 to 1993.

Academies and financial practitioners have dedicated immense efforts trying to resolve the puzzle of IPO underpricing. Nonetheless, the existing studies are still limited in scopes. Empirical studies continue to provide further evidence supporting the assertion that on average IPOs are underpriced. Yet theoretical models are not completely satisfactory in explaining the abnormality of IPO underpricing.

By correlation analysis, empirical studies did identify some possible causes of IPO underpricing. In summary, the suggested causes are (1) impact of prevailing market condition of the time when new shares are issued; (2) underwriter's pricing and marketing behaviors; (3) underwriter price support; (4) influence of underwriters reputation; (5) underwriting methods; (6) regulatory factor; (7) initial offer price; (8) issuer's risk proxy; (9) investors' uncertainty and (10) segmentation of industries of offering companies. Analytical works concluded on isolated observations offer certain explanations, but often they neglect the entire environment within which IPO underpricing takes place, namely the IPO institutional framework.

In comparison to the empirical studies, IPO underpricing literature presents much fewer theoretical models. In some of these models, IPO underpricing is theorized as a consequence of informational asymmetries existing among the three major participants of IPO process. Each of issuers, investors and underwriters respectively possesses distinct pieces of information upon which an IPO's value is judged. To overcome such informational asymmetries, the existing models usually designate one of the three major IPO participants as a dominant determinant in IPO pricing process (such as investors in Rock model, issuers in Welch model and underwriters in Baron model).

Despite good intentions, a fatal weakness of the previous models is that the models are developed from economic theories and are remote from either institutional procedures imposed by regulations or common practice of the business world. Therefore, they fail to provide satisfactory answers to the puzzle of IPO underpricing and lack practical values to practitioners in the financial world.

### 1.2. Objectives of the Current Study

The current study attempts to bridge the cap between the knowledge of academies and business practitioners. Taking an approach unavailable in the previous studies, the current study emphasizes the importance of the financial environment, namely institutional structure, within which IPO underpricing occurs, and the study does in-depth analysis on the IPO procedures imposed by regulations. The author argues that institutional framework in particular countries, such as the United States and United Kingdom, produce direct impact on IPO underpricing.

More specifically, this study intends to analyze IPO underpricing from the perspectives of the real business world, namely, institutional framework and its related financial market environment. Strictly regulated institutional procedures, such as events of filing, red herring, road show, pricing, offering and first day trading, have decisive impact on IPO underpricing. IPO underpricing is developed from red herring date through first trading date. Therefore, in this dissertation, attempt is made to identify and establish key institutional variable which may well describe an institutional framework derived from the theoretical discussion. Empirical tests mainly focuses on examining the explanatory power of institutional variable on underpricing.

Compared with the previous studies, this study has three distinct features. First, it employs more observable and measurable variables to investigate possible causes of IPO underpricing. Secondly, the theory developed is based more on institutional concerns. Finally, the study is unique in the sense that it presents a model built upon institutional and financial parameters within which IPOs come to the market, thus more truthfully reflects the real IPO world.

Furthermore, the current study establishes a measurable institutional variable i.e., a demand index expressed by mean red herring price and offer price. Newly defined demand index makes it possible to predict probability and magnitude of anticipated underpricing by observing the position of final offer price in relation to high or low end of the initial filing price range.

## 1.3. Model

A comprehensive model is developed to describe the time sequence of IPO process. The model optimizes both issuers and investors on the time sequence.

A number of original definitions are introduced in the model. Information used for IPO price decision making is categorized as (1) internal information and (2) external information. Variables of internal and external information, especially institutional variable, are introduced respectively to comprehend the model.

Investors are classified as experienced and inexperienced, and their respective functions at each stage of the IPO process are investigated. The model contends that experienced investors are usually able to purchase new issues in the IPO market; while inexperienced investors have to buy new issues in the secondary market and, therefore, have profound impact on the first trading day price.

From a general optimization of investors' expected utility and a basic balance equation, an equilibrium is reached. Based on these two exercises, the dissertation then derives a series of useful formula which depicts a linear relationship between initial return and demand index plus other market or accounting variables such as interest rate, total offer size (proceeds) and numbers of new offerings (hot/cold market index).

Theoretical analysis of the dissertation is composed of two parts: (a) a basic model and (b) an advanced model or a model for approximation. The basic model assumes that issuer knows true demand for the IPO, i.e. the issuer knows how investors assess the IPO's aftermarket prospects and the issuer also knows investors' risk preferences. The advanced model, on the other hand, removes such simplistic assumptions.

*The Basic Model*

The first step of the basic model is to infer investors' demand for the IPO, by deriving their utility-maximizing demand function from their underlying portfolio optimization exercise. In other words, investors choose an optimal demand which will maximize their expected utility.

The second step is to analyze how the issuer will select an optimal offer price based on investors' demand function which is derived in step one. In fact, the issuer tries to select an IPO price to make demand (under such optimal price) equal to the number of shares the issuer wants to offer. This price is the optimal price that will guarantee full sales of the IPO issue.

*The Advanced Model*

The advanced model, that is model for approximation, acknowledges that the issuer may not have complete information about the true demand for the new issue, i.e., the exact degree of risk aversion among potential investors or their assessment of the IPO aftermarket performance. Therefore, the model approximates the process of information gathering stage by a maximum likelihood method.

The issuing team files an initial price range with the SEC, and then takes its proposal on a road show. In its meetings with potential investors, especially institutional investors, the issuing team gets several observations on the likelihood that the demand for the issue within the tentative initial filing price range.

After maximizing of the likelihood of observed demand, the parameters of the true investor demand is determined, or a conjectured demand is reached. Using this conjectured demand, the issuing team then selects the final issue price to maximize the issuer's expected utility.

The initial filing price range can be described as a means of motivating the generation of information about the unknown parameters, and underwriting as a way of covering the residual risk of undersubscription that remains due to possible errors in parameter inference. The role of underwriting increases the accuracy of approximated demand.

***Implications of the Model to be Tested***

The model presents a proposition that IPO underpricing is (1) an increasing function of demand $\beta$; (2) an increasing function of the risk-free interest rate $r$; (3) an increasing function of the number of IPO shares offered $N$ (as well as total proceeds $P \cdot N$); (4) an increasing function of the aftermarket variance of IPOs $\sigma_v^2$; (5) an increasing function of investors' (absolute) risk aversion $\gamma$; (6) a decreasing function of the expected aftermarket price of IPOs $\bar{V}$, and (7) decreasing function of offer price $P$. The first three propositions will be tested by the empirical study in Chapter Seven.

## 1.4. Empirical Analysis: Data and Methodology

***Data***

The sample analyzed in this study consists of all the IPOs issued in the United States from January 1, 1988 through December 31, 1993. The total valid number of issues is 531, representing all industries in manufacturing sector and commercial banks. The raw data was provided by Securities Data Company and the data was verified through the Bloomberg system.

***Core and Board Definitions of Underpricing***

The author introduces one core and two broad definitions of IPO underpricing which is unknown to the previous studies. (1) Core definition of *UTF* which is similar to traditionally defined underpricing, is defined as $UTF=(T-F\cdot Adj2)/(F\cdot Adj2)$ where $T$ is first trading day closing price and $F$ is offering price, and *UTF* indicates the position of the first trading day closing price in relation to the final offer price; *Adj2* is the relative change of DJIA from offer date to first trading day. The first of the two broad definitions, (2) *UFM*, is defined as $UFM=(F-M\cdot Adj1)/(M\cdot Adj1)$ where $F$ is offering price and $M$ is mean initial filing price, and *UFM* indicates the position between final offer price shown in the final prospectus in relation to the mean of high-low red herring price; *Adj1* is the relative change of Dow Jones Industrial Average (DJIA) from red herring date to offer date. The second of the two broad definitions (3) *UTM*, is defined as $UTM=(T-M\cdot Adj3)/(M\cdot Adj3)$ where $T$ is first trading day closing price and $M$ is mean red herring price, and *UTM* indicates the position of the first trading day closing price in relation to the mean of the red herring price; *Adj3* is the relative change of DJIA from red herring day to first trading day.

To sum up, this study is built upon the assumption that for an individual IPO there could be three defacto broadly defined underpricing appearing at two stages of the IPO price determination process. (1) In first stage underpricing *UFM*, i.e., underpricing in the final offer pricing stage or underpricing of primary market, is principally a reaction to the market demand solicited during the pre-marketing period. (2) In second stage underpricing *UTF*, i.e. underpricing witnessed at the end of the first trading day or underpricing of secondary market is the consequence of underwriters' exercise of allocation discretion in the primary market. Such discretion in allocation further stimulates demand and pumps up IPO trading price. (3) In *UTM*, underpricing is merely the accumulative effect of both *UFM* and *UTF*. In other words, for a particular IPO, there could be three different and measurable underpricing, namely *UFM*, *UTF* and *UTM*, of which only *UTF* is traditionally defined underpricing and will be used as core definition of underpricing throughout the study.

***Demand Index***

The key institutional variable of this dissertation is demand index. Since subscription information on market demand for IPO is treated strictly confidential and usually not releasable to the public, the relationship between demand and underpricing is analyzed from another formative angle. Demand index can be defined as either a spread from $M$ to $F$ (i.e. $(F-M)/(H-L)$), or as the second stage underpricing *UFM* where

$UFM=(F-M*Adj1)/(M*Adj1)$. When we compare two definitions of demand index, we found that the spread definition ($(F-M)/(H-L)$) is highly correlated with the underpricing definition *UFM* (correlation=0.94). To avoid frequent cases of $H=L$ where the spread definition goes infinity and meaningless, we choose market adjusted *UFM* as the proxy of demand index. From both institutional and empirical aspects, *UFM* is the best index that authentically and accurately describes the quantity of demand occurring during road show.

The author thus suggests that *UFM* be a good proxy of the demand $\beta$. Such a proposition, as shown later, is demonstrated in 6.1.4. The author then applies *UFM* as a demand index which employs the relative distance between the final offer price and mean of the initial filing price range (also known as the red herring price) to indicate demand. It contends that when the final offer price is closer to the higher end of the high-low initial filing price range, demand on the IPO is high. While if the final offer price is closer to the lower end of the initial filing price range, the market demand on new issues is low.

Demand index *UFM* is linked to two key prices, namely red herring price ($M$) and final offer price ($F$). These two different IPO offering prices proposed by issuers reflect issuers' original and revised expectations on the market's reception of their offering stocks. While the first price determination is built upon issuers' internal accounting information, the second price is modification based upon additional external market information.

The author believes that *UFM* is a suitable institutional variable to summarize most institutional factors among major events related to underpricing. *UFM* crosses the time span of road show when demand information is collected.

***Empirical Test***

A comprehensive empirical analysis is conducted in which hypotheses exploring underpricing and various explanatory variables are proposed and tested. Methods to test these hypotheses are described subsequently.

The first part of the empirical study is a univariate analysis. The purpose of the analysis it to compare explanatory power of institutional variable with other market variables and accounting variables. In the section of the univariate analysis, we will begin with a key institutional variable *UFM* and examine its explanatory power relating to underpricing. Then we will check, one by one, other important market variable and accounting variable abstracted from our theory and literature, namely interest rate, proceeds and hot/cold market index.

The second section of the empirical analysis is devoted to a multivariate analysis on the sample of 531 IPOs to investigate and approximate the relationships between

underpricing and a mix of explanatory variables. I will apply an institutional variable *UFM* among the mix of other variables (interest rate, proceeds, hot/cold index, industry index, spread and interactions) to see and confirm that institutional variable has the most explanatory power.

Although the multivariate analysis can automatically select variables which have most explanatory power and eliminate other less explanatory variables, I kept the univariate analysis because it disclosed some non-linear relationship between underpricing and those less powerful variables (such interest rate). In addition, I can disclose detailed characteristics and changes of certain variables (hot/cold index) in different interest rate environment.

## 1.5. Findings

***On average, IPOs continue to be underpriced.***

The analysis of the sample supports the previous findings that IPO underpricing is an ongoing phenomenon. Of the sample studied, 394 (74 percent) are found to be underpriced at an average of 15 percent, 137 (26 percent) overpriced at an average of -3 percent.

***Formation of hot and cold market is relevant to interest rate at the time when IPOs are issued.***

The analysis in this dissertation reveals that when risk free interest rate reached its highest level in 1989 (8 percent), only 35 IPOs (total $1.5 billion proceeds) were issued in the United States. While in 1993, when interest rate reached the record low in 30 year (3 percent), an unprecedentedly large number of IPOs, 166 issues (over $11 billion proceeds) went to the US market. It is concluded that formation of hot/cold market is associated with the financial environment represented by risk free interest rate. Volumes of IPOs coming to the market are negatively correlated to concurrent risk free interest rate.

***Higher interest rate is more likely to produce underpriced IPOs.***

(a) There is a gap between the concurrent interest rates accompanying the issues that are underpriced and the issues that are overpriced.

(b) An one-side two sample t-test is employed to investigate the discrepancies of prevailing interest rate occurring along with underpriced issues and overpriced issues respectively. T-test is significant, supporting the hypothesis that risk free interest rate is higher when underpriced IPO issues come to the market compared with the time when overpriced IPOs are issued .

(c) Based on the empirical results of both univariate and cross-sectional models, a linear relationship between interest rates and IPO initial returns can not be established, however evidence indicates that interest rate influences underpricing in a non-linear way.

***The institutional variable demand index has most explanatory power.***

The final decision on IPO price is not made solely based upon issuers' subjective capital raising concerns, but a reflection of IPO investors' collective investment tendency at the time, and *UFM* is an immediate response to the market demand.

The initial filing price range reflects only the underwriter's perception of the quality of a new issue, while the final offer price (or final filing price) incorporates the information of market demand solicited during the pre-selling period. When the demand is high, the offer price moves closer to the high end of the initial filing price range, and vice versa.

The conventionally defined underpricing *UTF*, i.e. the difference between the offer price and the first trading day closing price, is twice affected by the market demand. Rationing exercised by underwriters before the first trading day can stimulate another round of demand for the shares being offered, thus producing higher underpricing by the end of the first trading day.

The empirical evidence from both the univariate and multivariate analyses all supports the notion that the demand index created by the author has the most explanatory and predictable power for explaining underpricing. A positive significant correlation is found between demand index (*UFM*) and underpricing (*UTF*) in both univariate and multivariate analyses. All other variables generally have no explanatory power in the univariate analysis.

***IPO underpricing is correlated with multi-factors.***

The cross-sectional regression analysis reveals correlation between underpricing and three factors, namely demand, inverse proceeds and the interactions of the two. The analysis shows that increase in underpricing corresponding to the increase in demand depends on the size of the total proceeds of IPOs being offered. In general, given a fixed total proceeds, underpricing increases as demand increases; and given a fixed demand, underpricing increases as the total proceeds increase.

***Projection of probability of drawing an underpriced issue***

The demand index created in the dissertation may be used to project the probability of underpricing. For instance, when the demand index *UFM* is higher than 0.0, meaning the offer price is above the mean of the initial filing price range, the probability is 80 percent for the IPO being offered to be underpriced. *UFM* can also

predict the magnitude of underpricing, for example, if *UFM* equals to 0.5 we may expect around 29.4 percent initial return at the end of first trading day.

### 1.6. Organization of the Dissertation

The chapters are organized in the following way. Chapter Two discusses the institutional framework of the IPO market. Chapter Three reviews the existing theoretical models of IPO underpricing. Chapter Four summarizes the results of empirical and correlation studies which offer evidence of IPO underpricing and perceived causes. Chapter Five discusses the foundation of the model created in this dissertation. Chapter Six presents the author's theoretical model, and Chapter Seven presents the author's empirical tests and results. Chapter Eight is the conclusion of the study.

# Chapter Two

# Institutional Procedures Applied to IPOs in the United States

## 2.1. Institutional Framework and IPO Underpricing

In a typical IPO process which usually lasts six months or more, there are at least five major events by which IPO underpricing is affected (a) filing, (b) red herring and road show, (c) pricing, (d) offering and (e) first day trading. Most of the previous academic studies explain the phenomenon of IPO underpricing from one or two particular factors unassociated with these important events in the IPO process. The impact of such events on IPO underpricing is generally overlooked. As a result, the existing studies lack thorough considerations of the relationship between underpricing and the overall IPO institutional procedures.

### 2.1.1 The Objectives of This Chapter

This chapter presents a detailed description of the institutional framework within which IPOs are conducted in the United States. It is hoped that such a discussion would enhance the argument and achieve the ultimate goal of this study engage an in-depth investigation on the influence of the above mentioned events on IPO underpricing.

The discussion on the five events in this chapter will lead to the introduction of the concepts of the variables to be applied to the theoretical model in Chapter Six and empirical tests in Chapter Seven. In order to portrait a complete picture of the IPO process, the discussion depicts chronologically every event that takes place in typical IPOs in the United States.

### 2.1.2 Sources of the Discussion

Major IPO events are presented by the time sequence in which typical

IPOs are conducted. These events take place either in compliance with the SEC regulations or following market practice. Consequently, the discussions develop around two themes: legal requirements and market practice in Wall Street.

**a. Securities Regulations**

Contents in sections of 2.4 (Filing Registration), 2.5 (Red Herring and Road Show), 2.6 (Pricing), 2.7 (Offering), 2.8 (First Day Trading) and 2.9 (Closing) are dominated by the major events that are governed by securities regulations. The sources for the presentations are mainly relevant regulations under Securities Act of 1933 and Exchange Act of 1934.

**b. Market practice**

In addition to the events governed by the regulations, other events described are guided by market practice in Wall Street. To fortify the arguments, market practice in these events are supported by citations found in company handouts by top six investment banks (namely Lehman Brothers, Merrill Lynch, Salomon Brothers, CS First Boston, Morgan Stanley, and Goldman Sachs), client manuals distributed by top six accounting firms (Coopers & Lybrand, Ernst & Young, Arthur Andersen, Price Waterhouse, KPMG Peat Marwick and Deloitte Touche Tohmatsu) and a few international law firms. For readers' convenience, a reference list is especially provided at the end of this chapter.

Market practices described are also based on a summary of the information obtained through extensive interviews and surveys with: two retired senior SEC officers (one former chairman and one former director of Division of Corporation Finance); eight well-known practicing security lawyers from reputable international law firms; ten investment bankers at managing director level from the top-bracket investment banks and ten partners from top six accounting firms.

Finally, the descriptions of the IPO process evolve through a typical IPO transaction abstracted from the IPO experience which this author was personally involved. This example IPO was underwritten by top-bracket investment banks: CS First Boston (managing underwriter), Merrill Lynch and Salomon Brothers (co-managers) and a syndicate group consisting 50 first class merchant banks worldwide. The experience by these 53 reputable institutions may well represent the market practice in Wall Street, and it is reasonable to believe that discussions derived from such broad sources would present a comprehensive picture of IPO practice and institutional features.

It should be noted that there is no clear cut in the above mentioned part (a) or part (b). Most of the events described are influenced by both securities regulations and market practice. It is only when securities regulations do not specify detailed guidelines for particular activities that market practice prevail.

## 2.2 Two Interims Separated by the Filing of the Registration with the SEC

For a company, going public or listing on a stock exchange symbolizes the firm's maturity and front-rank status in its industry in terms of assets, earnings and public acceptance. In the United States, corporations interested in issuing equity shares to the public are required to be registered with and declared effective by the Securities and Exchange Commission (SEC), an agency of the federal government.

### 2.2.1. Assumptions of the Discussion: Firm Commitment Offering

There are two kinds of underwriting agreements in IPOs: firm commitment and best efforts (Ernst & Young, 1993). The current discussion focuses on the institutional setting for IPO procedures which are generally followed in a standard firm commitment underwriting in the United States.

In a firm commitment underwriting agreement, underwriters agree that they will purchase the shares being offered for the purpose of resale to the

public. The underwriters must pay for and hold the shares for their own account if they are not successful in finding public purchasers. This form of underwriting is usually used by larger underwriters and it provides that greater assurance of raising the desired funds.

In a best efforts underwriting arrangement, the underwriters agree to use their best efforts to sell the issue as the company's agent. If the underwriters cannot find purchasers, the issue is not sold. While some best efforts agreements provide that no shares will be sold unless buyers can be found for all, others set a lower minimum, such as 50 percent (Ibbotson, 1988).

### 2.2.2. General Timetable: Two Interims

IPO procedures, in terms of time line, can be described by two major interims: (1) preparation prior to the filing of the registration statement with the SEC and (2) post the filing of the registration statement.

Interim One begins with organizational meetings, also known as all-hands meetings, and ends with the filing of the registration statement with the SEC. Interim Two commences with the filing of the registration statement with the SEC and ends with the closing under the over-allotment or green shoe option (However, it should be noted, that over-allotment is not a feature included in all IPOs).

The overall time lapse between the beginning of the preparation of a company's first registration statement and the final effective date is usually three to six months (Arthur Andersen, 1995). The maximum time limit is due to the fact that SEC's rule relating to the updating of financial statements requires the most recent financial statements to be as of a date within 135 days of the expected effective date (Regulation S-X, Rule 3-12; 17 Code of Federal Regulations §210, 3-12, 1991). However, such time limit does not guarantee that an offering can be completed in the time frame, and it may well exceed six months sometimes.

Generally speaking, the timetable for an IPO follows the sequence described below (Coopers & Lybrand, 1995). For the convenience of discussion, the starting date of each interim will be defined as Day 1. For instance, the dates of the various activities in Interim Two will be described by reference to the first filing date, Day 1, and the 10th day following the filing of the Registration statement will be referred to as Day 10.

**a. Major Events in Interim One**

Preparation of a public offering commences with an issuing firm's preparation for auditing and selection of underwriters. Timetable of activities in Interim One is more flexible in comparison with that in Interim Two. However, since the auditing results are supposed to be valid for 135 days only, all preparation of the registration and the final amendment must be completed in 135 days. Otherwise, updated financials are required (Arthur Andersen, 1995).

| | |
|---|---|
| Organizational Meeting | Day 1 |
| Auditing and Preparing Financial Statement | Day 1 to 60-80 |
| Due Diligence | Day 1 to 60-80 |
| Drafting of the Prospectus | Day 1 to 60-80 |
| Accounting Reconciliation | Day 40 to 50 |
| Filing Listing Application with Stock Exchange | Day 81 |
| Filing the Registration Statement with the SEC | Day 81 |

**b. Events in Interim Two**

After the initial filing or the first filing, several amendments may be required by the SEC before the final filing. To simplify the discussion, we assume that (1) the first amendment will be able to satisfy the SEC's disclosure requirements, thus the red herring can be printed based on the first amendment and be distributed; and (2) the second amendment will be able to include pricing information and will be the final amendment to the registration statement.

It should be noted that starting from Day 60 to Day 64 days are referred to business days rather than calendar days.

| | |
|---|---|
| Filing the Registration Statement with the SEC | Day 1 |
| Receiving SEC Comments | Day 30 or after |
| Submission of the First Amendment, Printing and Mailing Red Herring | Day 40 |
| Determining and Filing Initial Offer Price Range with the SEC | Day 40 (no later than Day 61) |
| Soliciting Indications of Interest | Day 40 to 60 |
| Road Show | Day 40 to 60 |
| Submission of the Final (Second) Amendment | Day 61 |
| Declaration of Effectiveness of the Registration Statement by the SEC | Day 63 |
| Signing the Underwriting Agreement, Finalizing Offering Price | Day 63 (after the Closing of Market) |
| Confirmation of Final Sales and Delivery of the Final Prospectuses | Day 64 (before Market Opens) |
| Start of Trading | Day 64 |
| Payment Due Date | Day 69 |
| Closing | Day 70 |

## 2.3. Interim One: Preparation of the Registration

### 2.3.1. Selection of an Underwriter or a Syndicate Group

Once a corporation decides to go public, the immediate decision that needs to be made and perhaps the most important decision too, is to select an underwriter. The leverage that underwriters chosen seems to have more influence in IPOs comparing with that of lawyer and accountants in terms of

setting offering price and offer size as well as marketability of the security offered (Johnson, 1991).

By regulations, accountants' responsibilities limit to accurately present the company's financial status which is reflected in financial statement and the supplemental information of the registration statement (Arthur Andersen, 1995). Company counsel is principally responsible for preparing the non-financial parts of the registration statement (Association of the Bar of City of New York, 1977). Neither accountants or counsel are required to be present at the pricing meetings. Consequently, it is necessary to discuss in-depth the selection of underwriters.

The main role that underwriters play in IPO is (1) to assist the company in presenting itself before the SEC to meet disclosure requirements, (2) to assist the company in valuing itself and pricing the security; (3) to market the company's stocks and (4) to provide the aftermarket support for the security being sold, such as taking the initiative in bringing the stock to the attention of analysts and investors and their customers (Securities Act of 1933, Section 2(11); General Regulation under Securities Act of 1933, Rule 144). In National Association of Securities Dealers Automatic Quotation system (NASDAQ), underwriters also serve as market makers that stand ready to purchase or sell the stock in the inter-dealer market.

If a prospective offering has merits strong enough to appeal to several large underwriters, there is likely a competition among the underwriters trying to sell themselves and their proposals to the company. Such an element of competition may well further arouse the underwriters' appetite, therefore put the company in a good position. Under this circumstance, the company may choose to select several investment houses as co-managers to handle the transaction. If a underwriter syndicate is chosen, one investment banking firm is usually selected as the managing underwriter or lead manager. Underwriters who underwrite an IPO are subject to liability under the Securities Act

(Securities Act of 1933, Section 11(a),(b)). Within the framework of a underwriter syndicate, a group of underwriters will share the responsibilities, rewards and risks of selling the stock to the public jointly.

### 2.3.2. Organizational Meeting

The organizational meeting is an important event in an IPO offering. The purpose of this meeting is first to form a working team and set it on gear to accomplish items on the IPO agenda. Secondly, at the meeting, all parties involved will agree upon a day-by-day event schedule to ensure that every deadline can be met (CS First Boston, 1992).

The organizational meeting generally focuses on three aspects, (1) coordination and communication, (2) planning and (3) scheduling. It is at this meeting that all professionals involved in the proposed IPO meet and get to know one and another. Telephone numbers and addresses are exchanged and contact persons of each party are designated. It is also at this meeting that procedures and agenda of the offering are planned in detail. Finally, consensus is reached on the role each party is expected to play and the responsible persons of each event. Such clarification enables each party of the group to have a clear understanding of its duties in the IPO.

### 2.3.3. Due Diligence

In preparation of the prospectus, a key part of the registration statement, much of the time and efforts are spent on due diligence by the company counsel, underwriters' counsel, underwriters and accountants.

The underwriters are legally liable for any material misstatements or omissions in the registration statement. In due course, they conduct reasonable investigation to assure that the statements were true and there was no omission of any material fact. This process is generally referred to as the due diligence defense. In a due diligence, the underwriters will insist upon undertaking,

together with their legal counsel, a thorough review of the issuer before the registration statement is filed. The scope and depth of this review in US are more strict than found in any other countries.

As part of a defense against Securities Act liabilities (Securities Act of 1933, Section 11(a)), due diligence investigation is to review the company's internal documents, discuss with its management, and verify all disclosures for accuracy and completeness (Ernst & Young, 1993). Due diligence may take a period of about three to five months. Included in the due diligence are (1) financial auditing of the company in accordance with US generally accepted accounting practice (GAAP) by reputable auditors, (2) investigation and evaluation of the issuing company by underwriters and their counsels, and (3) background study by the underwriters about the whole market to ensure that the transaction is a good one.

Managing underwriter with the help of the company counsel performs much of the due diligence investigation and their insights are reflected in the disclosure documents. Due diligence investigation, in a sense, is a process in which prospective investors' interests are protected with the help of professionals. Underwriters are responsible to determine the company's eligibility for issuing public offering by evaluating the amount of the company's sales and earnings, the adequacy of its present and projected working capital and cash flow positions. The underwriters will also consider the experience, integrity and quality of the company's management, as well as the growth potential of the company in its business, its customers, its source of supply and its ability to diversify.

### 2.3.4. Auditing

Auditing by a prestigious accounting firm is a critical part of the IPO process (Price Waterhouse, 1993). Pursuant to Securities Act of 1933, a large proportion of the prospectus is devoted to the audited financial statement

(Securities Act of 1933, Section 7(a)). Reviews by the SEC accounting staff very much focus on the accounting rules and accounting practice employed by the issuer, and a big proportion of the SEC comments are related to the auditing results complied by US GAAP (Arthur Andersen, 1995).

As a market practice, most sizable or significant issuers hire one of the top six accounting firms that have international reputations and experience in dealing with the SEC as their IPO auditor (Ernst & Young, 1993). For most IPOs, the SEC requires that three years of audited financial statement be presented in the prospectus (Ernst & Young, 1993). Auditing involves checking the original accounting records and all material contracts, physically counting of the inventory, and verifying sample invoices and transactions (approximately 5 percent) (Arthur Andersen, 1995).

As part of the registration statement, audited financial statement requires to be in accordance with US GAAP. In the case of an international firm, if foreign GAAP is used for original financials, a quantitative reconciliation to US GAAP of the materially different items in the financial statements is necessary and critical in the auditing process.

### 2.3.5. Drafting the Registration Statement: Cooperation among All Parties Involved

It is usually the company counsel's responsibility to draft the non-financial parts of the registration statement (Association of the Bar of the City of New York, 1977; Schneider, 1972), and drafts are then circulated to all concerned. It usually takes several major revisions pending on the SEC comments before the final filing. Close cooperation is important for the company counsel, company's management, underwriters' counsel, underwriters, accountants and printer.

#### a. Company Counsel

The company counsel normally assists the company and its management

in preparing the document and performing due diligence. The company counsel often serves as the principal draftsperson of the registration statement (Association of the Bar of the City of New York, 1977; Schneider, 1972). To do so, the counsel solicits information from various sources and exercises judgment in evaluating the information received for accuracy and consistency.

Professional obligation requires the counsel to be skeptical to information provided by the management of the company and pursue an investigation when suspicions rise about the accuracy of the information received (Arthur Andersen, 1995). The counsel will prevent the company to include in the registration statement information which is known or believed to be inaccurate or overstated.

However, the company counsel will not act as the ultimate source to investigate or verify all disclosures in the registration statement. Nor will the counsel assure that the document is accurate and complete in all respects. As a matter of fact, often the counsel does not have the technical background or expertise in the company's business, and has to depend on the management on the information of the business (Schneider, 1972).

**b. The Company's Management**

The management of the company has the responsibility to provide full and accurate information for the registration statement. However, it is not uncommon that the management overestimates their ability to give accurate information from their recollections. Because of the counsel's lack of technical expertise in the company's business, the management should take initiative in cooperating with the counsel and cannot rely entirely upon the counsel to ask the right questions and verify the information provided.

**c. Accountants**

In order to encounter financial disclosure problems and inconsistencies between the narrative text and financial statement, availability of the accountants to append the draft statements and supply background information

is essential while the prospectus is written.

The text of the prospectus is often written by the counsel before the financial statements are available. Often, the lawyers and accountants may have different understandings as to the structure of a transaction. When the counsel wrote the prospectus based upon the assumptions regarding the financial statement treatment of a transaction which is not yet available, the full financial implication of some important matter might be missed. Inputs by the accountants are, therefore, extremely important.

## 2.4. Filing Registration Statement with the SEC

The structure described in this chapter is that of a relatively uncomplicated registration for a first time issuer. To simplify the discussion, the assumption is that the registration statement will be declared effective after two amendments are submitted, although in reality often it is necessary to file more than two amendments in addition to the first filing.

### 2.4.1. Complying Governing Laws: the Securities Act and Exchange Act

Issuance and trading of securities in the United States are governed mainly by two federal laws, the Securities Act of 1933 (Securities Act) and the Securities Exchange Act of 1934 (Exchange Act). While the Securities Act governs the registration of offerings of securities and the prospectus used for offering, the Exchange Act governs the matters related to trading and market and issuers' continuous reporting.

The SEC, as a regulatory agency of the US federal government, has no authority to judge the merits of a particular offering, nor does it have the power to prohibit an offering even the issue is considered a risk for investors (Coopers & Lybrand, 1995). However, the SEC promulgates rules and enforces the federal securities laws which were designed to prohibit the public distribution of

securities without disclosure of necessary information enabling investors to make an informed investment decision.

The registration provides with the SEC with the information necessary for it to authorize the listing. The registration also supplies the financial community with what it needs to judge the security's investment merit. The first filing of the registration statement is a public event and will be reported (generally in a cursory manner) by the press. The issuer or underwriters may issue a brief press release announcing the filing.

### 2.4.2. Registration under the Securities Act: Disclosure Requirements

The registration statement is the disclosure document required to be filed with the SEC for the purpose of a registered offering (SEC Securities Act Release No. 6383, 1982). To begin the registration process, the issuer first files a registration statement with the SEC. The registration statement under the Securities Act is the disclosure document (SEC Securities Act Release, Nos. 6331-38; 6949, 6950) and it consists of two parts: (1) prospectus and (2) supplemental information.

The prospectus is a legal offering document and is required to be distributed to each investor. The supplemental information is filed with the SEC and is available for public inspection at the office of the SEC, but it is not required to be distributed to investors (Ernst & Young, 1995).

The amount of disclosure required in the registration statement varies and is ruled by the registration form applicable to the kind of the offering being made and the issuer. For the first time issuers, maximum disclosure is required under one form, while for companies that are already reporting under the Exchange Act (already did the first offering), minimum amount of disclosure might be required.

#### a. The First Part of the Registration Statement: Prospectus

Prospectus is the only document delivered to prospective investors

during the offering. Prior to effectiveness of the registration statement, such a document is referred as a "preliminary prospectus" also known as the "red herring." (Regulation S-K Item 503, Forms under Securities Act, Form 1-A).

***Required Disclosures***

The prospectus describes the company's business, properties, the terms and amount of the security being registered, and lists all the financial information demanded by the disclosure requirement. The customary sequence for organizing the prospectus begins with "Business" and is followed by "Management", "Dividend Policy", "Use of Proceeds" and "Underwriting".

The company is required to describe in detail its business, properties, supplies, markets, and its directors and officers. It is also required to disclose the details of the underwriting, the plan of distribution of the security, capitalization, description of the security being registered, options to purchases of the security, and principal holders of the security. The company must add any information necessary in addition to the disclosure requirements to make sure that the statements is not misleading (General Regulation under Securities Act of 1933, Rule 408; 17 Codes of Federal Regulations §230,408, 1991).

***Dual Functions of the Prospectus***

The prospectus serves two purposes: (1) to sell the company's security and (2) to disclose the company. Such dual purposes of the prospectus often present conflicts to each other. In order for the underwriters and dealers to sell the security to the public, the prospectus tries to present the best possible image of the company to the public.

However, as a disclosure document and protection against liabilities, the prospectus cannot paint everything rosy. The 1933 Act makes it rather easy for investors in new issues to establish claims for losses against the parties involved in an offering if problem develop after the offering and the price of the security declines. Both civil and criminal liabilities can result from material misrepresentations or omissions of information. The SEC reviews registration

statement for compliance with its rules, but such review does not provide relief from potential liabilities.

As a result, the new issue process in the US is heavily oriented towards minimizing legal risks, primarily through expanded disclosures that focus on potential negative future consequences rather than on optimistic future prediction (Arthur Andersen, 1995). The ultimate responsibility of presenting accurate information is the company's executives, financial and accounting officers. It is the company and the underwriters involved that are subject to liability under the Securities Act.

Putting together a good prospectus is, therefore, an art. "This is an art that can be learned only by experience" (Johnson, 1991). For experienced underwriters and counsels who have knowledge of SEC staff attitude and potential civil liabilities, the strategy is to make conservative presentations and avoid over-optimistic predictions.

**b. The Second Part of the Registration Statement:**

**Supplemental Information**

The second part of the registration statement contains information that is not required to be in the prospectus but is required to be filed with the SEC. This part is not required to be given to each investor. Different from the first part of the registration statement (prospectus), the second part is in the question-and-answer format (Regulation S-K, Item 301).

Contained in this part are supplemental financial schedules as well as specific exhibits required by the SEC. Such exhibits include the certificate of incorporation and by-laws or comparable organization documents, opinions of counsel, material contracts and loan agreements, voting trust agreements and a list of any significant subsidiaries (Coopers & Lybrand, 1995).

In addition, one of the exhibits included in the registration statement is the underwriting agreement in its reasonable final form. Revisions to the underwriting agreement can be submitted in subsequent filings of amendments

to the registration statement, but by the time of the final filing the underwriting agreement on file should include the final terms of the underwriting arrangements other than pricing and related information (Ernst & Young, 1993).

### 2.4.3. Registration Under the Exchange Act

Companies making a public offering registered under the Securities Act are often advised by their underwriters to have their securities listed on a stock exchange or quoted on the NASDAQ to enhance their marketability (CS First Boston, 1992). Once a company has conducted a registered public offering, the company must comply with the registration and reporting obligations under the Securities Exchange Act of 1934.

In contrast to the registration under the Securities Act, registration under the Exchange Act involves a one-time registration of an entire class of Securities of an issuer, e.g. common shares (Exchange Act, Section 13). The registration under the Exchange Act is not limited to a specific amount of Securities of that class. Accordingly, once a class of securities is registered under the Exchange Act, no additional registration statement needs to be filed under the Exchange Act when additional securities of such class are issued.

Less extensive financial disclosure requirements applicable to 1934 Act filings comparing with 1933 Act filings, reflect the higher standard historically imposed by the SEC on companies that are raising new capital in public offerings of securities as opposed to companies whose previously issued securities are traded in the US capital markets.

A registration statement filed relating to the listing of securities on a national securities exchange becomes effective 30 days after the receipt of certification by the SEC from the relevant exchange of its approval of the listing or at an earlier date as the SEC determines.

### 2.4.4. Registration under State Laws

In addition to complying with the US federal laws, a company registering its security must also register or find an exemption from registration under relevant state laws, usually known as "blue sky laws" of any state in which the security is to be offered (Securities Act of 1933, Section 18).

State registration usually involves filing a copy of the registration statement and any amendments when they are filed with the SEC. Such registration usually can be accomplished in the same time frame as the registration under the federal securities laws.

### 2.4.5. Admission to a Stock Exchange

If the company wishes to be listed in a stock exchange, e.g. the New York Stock Exchanges (NYSE) and the company has been given informal indication by the exchange that a listing application will be accepted, such fact is disclosed in the prospectus (Regulation S-K, Item 202). In the case of NYSE, six draft copies of the application are required to be submitted to the NYSE at least three weeks before the application is desired to be acted upon (New York Stock Exchange Guide, §24954A-2495E). The NYSE will take action on an application as soon as any necessary revisions have been made, and the file of supporting documents completed.

Admission to trading normally takes place within 30 days after NYSE action. A company that has qualified for listing can normally expect its shares to be admitted to trading within four to six weeks after filing original listing application.

### 2.4.6. The SEC Review Process

After the registration statement is filed, it is reviewed by the SEC's Division of Corporation Finance. By the terms of Securities Act Section 8(a), a registration statement becomes effective on the 20th day after filing. In

practice, however, it does not become effective until declared effective by the SEC staff (Johnson, 1991).

The time needed between the filing date and receipt of SEC's letter of comment varies. The most recent SEC policy requires that an initial letter of comments be given to the applicant within 30 days of the filing of a registration statement (Coopers & Lybrand, 1995). However, for planning purposes, it is usually assumed that the staff of the SEC would, in approximately 30 to 35 days, deliver a letter containing comments on the Registration statement.

The time required for the SEC to process a registration statement is sometimes affected by a heavy backlog at the SEC and season of the year. It is believed that there is a considerable rush of filing at the end of each calendar quarter, particularly at the end of March for filing with financial statements as of December 31 (Johnson, 1991). The time needed may also be affected by the complexity or sensitivity of the offering. In either case, the waiting period for the SEC's initial comments may well exceed 30 days. For the purpose of simplifying our discussion, we assume that the comments of the SEC staff are received on Day 30.

The SEC is aware of the fact that dollar amount of securities for transaction can possibly increase as a result of delay. Accordingly, the SEC's resources are concentrated on initial public offerings (Schneider, 1972). For existing public companies, review is on selective basis, while for some established issuers no review is conducted (SEC News Digest, 1980).

### 2.4.7. SEC Comments

There are usually separate reviews for the financial and non-financial portions of a filing. SEC staff almost always finds defects in the initial registration statement and requires additional disclosures. SEC comments are usually made by branch chief of the Division of Corporation Finance to the company counsel through the "letter of comments" also known as "deficiency

letter" (Price Waterhouse, 1993). This will include the areas of the statement that the SEC believes to be incomplete, unacceptable or has questions concerning disclosure. Accounting comments sometimes will be made in separate letters by the SEC's accounting staff (Johnson, 1991).

SEC staff comments may vary. According to my interviewees, areas that receive particular attention in the review process include: the required management discussion, analysis of financial condition, results of operation, liquidity, capital resources, effects of inflation, use of proceeds, and transaction between the issuer and related parties.

Although the SEC cannot prohibit an offering when disclosure is adequate, its policies on disclosure can make the offering look highly unattractive. If there are sufficient unfavorable factors in an offering, information on the risk is required to be listed (General Regulation under Securities Act of 1933, Rule 144). Perceived risk factors include lack of business history; adverse business experience; operating losses; dependence upon particular customers suppliers and key personnel; lack of a market for the security offered; and competitive factors. Usually, such factors are stated in the very beginning of the prospectus under the headings such as "Introductory Statement," "Certain Consideration" or "Risk Factors of the Offering".

### 2.4.8. Amendments

Time needed for revision varies depending on the SEC comments and the extent of work required to respond to them. In our example, from Day 30, the issuer, counsel, underwriters and their counsel and accountants start to work on a revised form of the Registration Statement, and prepare to file the first amendment to the SEC. We assume that the first amendment is filed on Day 40.

To comply with the SEC comments, the focus will be on the points raised by the SEC staff. However, if significant developments occurred after

initial filing, such developments must be reflected in the new revision to ensure that all statements are updated and accurate even if they are not covered by the SEC comments (Securities Act of 1993, Section 8(a); Regulation C under Securities Act of 1933, Rule 472). Normally, more than one amendments will then be filed with the SEC for further review. When the SEC is satisfied that its comments have been adequately addressed, it will declare the registration statement effective. Only after the registration statement is effective, can sales to the public take place.

### 2.5. Red Herring and Road Show: Soliciting Indications of Interests

The waiting period begins when the registration statement is filed with the SEC and ends on the effective date of the registration statement (General Regulation under Securities Act of 1933, Rule 456). This period may be further divided into two sub-periods. In the first period, the issuing team focuses on the amendments responding to the SEC's comments and the only publicity that the issuer or underwriters are permitted is a brief press release announcing the filing (the content of which is prescribed by rules established by the SEC). Once the issuing team is satisfactory with the amendment, the preliminary prospectus (red herring) is printed and filed with the SEC, and road show immediately follows, thus starting the second part of the waiting period.

#### 2.5.1. Selling Efforts Forbidden Prior to Filing

Prior to the initial filing of the registration statement, public offering, either orally or in writing, is forbidden (Securities Act of 1933, Section 5(c); 15 US Codes §77e(c), 1988). The company is permitted to make limited announcements concerning its intention of making a public offering (General Regulation under Securities Act of 1933, Rule 135; 17 Codes of Federal Regulations §230,135, 1991). However, it is illegal for the company to launch any promotion, either the company itself or its products, for the purpose to

stimulate an interest in the security even if the security is not mentioned (SEC Securities Act Release Nos. 5009, 4697, 3844).

### 2.5.2 Red Herring

After having received and responded several rounds of the comments by the SEC, if the issuer and underwriters are reasonably confident about the information contained in the preliminary prospectus, and if it is felt that no further amendments will be required to the registration statement, the last version of the registration statement will be used as base of the preliminary prospectus and will be printed and circulated among prospective investors. The pre-marketing period begins.

During this period, oral offers my be made but no written offers are permitted. The only written material allowed to solicit investors is the preliminary prospectus (General Regulation under Securities Act of 1933, Rule 430; 17 Codes of Federal Regulations §230,430, 1991). The preliminary prospectus must contain substantially information required to be included in the final prospectus and must include a red legend on the front cover (hence named red herring).

### 2.5.3 Pre-Marketing: Oral Selling Efforts Permitted

With the distribution of red herring, pre-marketing period begins. Once the pre-marketing period begins, by making telephone calls and use of the red herring, the underwriters' sales personnel may offer the security to prospective investors. Based on the knowledge contained in the preliminary prospectuses, prospective investors may give "indications of interest" to the underwriters' sales personnel orally. However, no sales or contracts for the sales can be made during this period of time until the registration statement is declared effective (Securities Act of 1933, Section 5(a); 15 US Codes §77e(a), 1988).

The response given by an investor who wishes to purchase the security is not an acceptance, only an "indication of interest." The investor remains totally free to refuse to purchase the security at any time prior to the confirmation of sale to him/her following effectiveness of the registration statement.

During this period of time, the only other written document besides red herring permitted is "tombstone advertisement" (Securities Act of 1933, Section 2(10); 15 US Codes §77b (10)(b), 1988). Resembles a tombstone advertisement, the printed material contains very limited notice of the offering and it is not considered selling literature.

In Franklin, Meyer & Barnett, a broker-dealer was sanctioned because he enclosed his business card with the red herring and wrote on it "phone me as soon as possible as my allotment is almost complete on this issue" (Johnson, 1991). It is believed that if this statement was not in written format the dealer would not have violated Securities Act Section 5.

### 2.5.4 Road Show and Bookbuilding

As part of the marketing effort, the company and underwriters will normally conduct a road show after the distribution of the red herring. In the road show, the managing underwriter may escort the company executives on a tour around the country and abroad (Ernst & Young, 1993). The underwriters arrange meetings with prospective institutional investors in a number of big commercial cities. At such meetings, the company's executives present information concerning the company and respond to institutional investors' questions face to face. At the road show, no documents other than the preliminary prospectus may be distributed, although slide and overhead projections are commonly employed.

Emphasis on institutional investors is not without reason. In the United States, institutions are a dominant force in the equity markets (CS First Boston,

1992). Purchases by institutions account for 60 to 70 percent of equity trading volume and even larger proportion of equity new issue purchases, and in contrast, purchases by retail investors rarely account for more than 15 to 25 percent of a new issue (Salomon Brothers, 1996). A successful road show would generate interests among investors and consequently result in large number of "orders". The road show under experienced underwriters also leave an unsatisfied demand level that will further help the after-market support and performance of the company stock.

During the road show, the orders constantly come in and underwriters' European, Asian and US equity syndicate departments accumulate tallies and levels of investor interests in the new offering, with the goal of building as strong a "book of demand" as possible.

## 2.6 Pricing

### 2.6.1. Valuation Procedure: Underwriters' Role in Proposing Price Range

Determination on the preliminary price range and offering size is mainly based on valuations conducted by both underwriters and the issuer. The underwriters including lead manager and co-manager use their professional knowledge and information obtained from the due diligence to reach the comprehension of the issuing firm's true value.

Although there is no standard formula, certain factors are always considered in the valuation process. First, the underwriters must consider the condition of the market as a whole at the time the IPO is undertaken. Secondly, prices of other successful and similar offerings will also come into play, as will the company's projected earnings and cash flow at the time of the offering. Price/earnings ratios and return on sales of other companies in the same industry may be used to extrapolate a price for the IPO offered. Finally, the underwriter will consider a host of other, more subjective factors, such as expected growth, recent prices paid by sophisticated buyers in private

transactions, inherent risk of the business, the company's stability and the after-market trading objectives.

The valuation is usually based on financial models built by the underwriters' financial analysts. A commonly used model is price/earning multiple measure which is built up with the inputs of the company's current and expected earnings, and universal or industry wide average price/earnings ratio plus some industrial adjustment factors, to give a valuation range of the issue (CS First Boston, Merrill Lynch and Salomon Brothers, 1992). Other valuation models include selected valuation measures of discounted cash flow analysis (or free cash flow), book value multiple and other private equity valuation. These valuation methods help underwriters determine market expectations of earning growth prospectus, relative risk of cash flow, proxy for liquidation value and provide comparative valuation worth to a strategic buyer (Lehman Brothers, 1996). Other comparison and qualitative factors such as growth potential, management and political stability are also take into consideration in the valuation process.

With a couple of rounds of negotiations, final valuation (mean and range) will be agreed by the issuer and accordingly a preliminary initial price range and total offer size will be reached. The underwriters' role at this stage is similar to that of the issuer's agent. The underwriters will help the issuing firm to maximize its cash proceeds because their fees are proportioned with size of the transaction. The objective of an equity pricing is to achieve the highest offering price consistent with strong after-market performance for the stock (Salomon Brothers, 1996)

### 2.6.2. Initial Filing Price Range Proposed on the First Filing

Underwriters generally cannot guarantee an offering price and total proceeds before road show. The final offer price is usually finalized before the day of first trading to reflect the market condition. However, for the purpose

of calculating the SEC filing fee, the underwriters must estimate an initial price range based on the market condition at the time of filing (Ernst & Young, 1993).

The first filing with the SEC must be accompanied with a registration fee which is calculated based upon total proceeds anticipated to offer. Therefore, maximum price must be determined at this time in order to calculate the fee. For each registration statement, a basic filing fee is at the rate of 1/29 of one percent of the maximum aggregate price at which the security are proposed to be offered (or $312.50 per $1 million proceeds) with a minimum fee of $100 and fee is non-refundable (Securities Act of 1933, Section 6(b); General Regulation under Securities Act of 1933, Rule 457; Public Law 102-104). Pursuant to general regulation Rule 144 under the Act, a filing registration statement "shall not be deemed to have taken place unless it is accompanied by a check for the amount of the fee required" (SEC Securities Act of 1933, Section 6(c)).

The method of calculating the maximum aggregate price varies. As a general matter, the fee will be calculated with some reference to the market price. For initial public offerings, where there is no established public market trading price, an initial price range is provided on the cover of the preliminary prospectus, and a filing fee is calculated on the basis of the higher price for the security set forth in the range (Linklaters & Paines, 1996). Price range amendment to the registration statement is permitted in later stage. However, any increases in the number or principal amount of the security initially registered will require the payment of an additional fee.

### 2.6.3 Initial Filing Price Range Confirmed on Red Herring

A high-low initial offer price range of the offering must be filed with the SEC in the first amendment (red herring) and no later than the second

amendment (or final prospectus in our example). The price range is printed on the cover of the red herring.

The Securities Act requires that any IPO preliminary prospectus circulated by issuer must include on the outside front cover page a bona fide estimate of the range of the total maximum and minimum per unit offering price and maximum (minimum) number of shares or other units to be offered (Regulation S-K, Item 501(c)(6)). The prospectus also must include a description of the various factors considered in determining the offering price (Regulation S-K, Item 505).

Based on the valuation assessments made by the underwriters and the company, the price range is indicated in the preliminary prospectus (Linklaters & Paines, 1996). On the final prospectus, this legend of price range will be replaced by final offer price, total proceeds, and underwriters' commission (Price Waterhouse, 1993). Even if the price range is not printed on the red herring in the cases where IPOs are filed under Rule 430A, still underwriters solicit indications of interest based on this price range (CS First Boston, 1992).

In general market practice, a mid point of the range is determined through a negotiation process in reference to the valuation results. Adding a constant integer or half integer (in our sample, they are 0, 0.5, 1 and 1.5) to the mean price results in the high-end of the initial price range, and subtracting the same constant from mean price establishes the low-end of the initial price range. In our sample, the range spread is $0 to $3, and no more than $3. Therefore, in practice, mean price can serve as a benchmark of initial price range to the investors (Linklaters & Paines 1996). The other way to reach the range is to obtain high-end from the maximum valuation and low-end from minimum valuation.

As mentioned in the previous section, setting the filing range for an IPO is done following a thorough valuation analysis, including an examination of the absolute trading levels of comparable companies on the exchange in which

the new company intends to list. Filing ranges tend to have a 10% to 20% spread of the filing price between the low-end and the high-end of the range. Setting initial price range is dictated by market practice as there is no legal requirement regarding the magnitude of the range which can be filed. Usually the narrower the range, the more confident the lead manager is in the accuracy of its valuation of the company (Lehman Brothers, 1996). In the model developed later in this dissertation, this mean initial filing price and final offer price as well as the first trading day closing price are used to define three concepts of IPO underpricing.

### 2.6.4. Valuation Discount Incorporated in Initial Filing Price Range

Determining the filing price range is an important step in IPO offerings. Although commonly misperceived to be a pricing decision, the filing price range is viewed as an important marketing decision by underwriters. Used properly, an initial filing price range provides an important marketing tool and signal to guide the market's perception of value of the issue.

In order to ensure a successful marketing effort and a good reception of the IPO issue, it is often advised that the initial price range should incorporate a modest valuation discount to comparable publicly traded equities. Modest valuation discount is referred to the difference between the mean initial filing price range and consensus of the mean of believed valuation price range. The company is advised by the underwriter to set an initial offer price range that will produce an active aftermarket. By pricing to allow a modest rise in the immediate aftermarket, public interest can be stimulated (Ernst & Young, 1993). In reality, often investors' demand is for the discount, not for the security offered (Buckland, 1995).

The discount varies depending on market conditions, offering size, and complexity of the deal structure. The market practice applied by major investment firms in Wall Street is to set the initial mean filing price slightly

under the projected aftermarket price, usually five to 10 percent lower (CS First Boston, 1992). Commonly known as an initial IPO discount or proposed IPO underpricing, discount is used as an inducement for investors to consider the investment merits of the company.

### 2.6.5. Final Price Range Amended

In a typical IPO, the period during which underwriters' salespersons solicit indications of interests and the road show is conducted, might last about one to two weeks. During this period of time, "orders" (indications of interest) constantly come in as a result of sales personnel's oral selling efforts, and underwriters have a rough idea about the demand on the security offered.

Based upon their perception, the underwriters will then discuss with the company about the demand that they have encountered for the security and will amend the price range and total offering size (Ernst & Young, 1993). When the company and underwriters have agreed upon the size of the offering and the anticipated price range, and all other aspects of the registration statement are satisfactory to all parties, the issuer will file a further amendment to the registration statement (the second amendment in our example). In our simplified example, this would be the final amendment prior to the effective date and hence should contain final copies of all exhibits, including the underwriting agreement in final form and final price information on the cover page. We will assume that such filing is done on Day 61, or 21 days after the filing of the first amendment.

### 2.6.6. Fixing Final Offer Price and Printed on Final Prospectus

The event of finalizing offering price, in terms of time sequence, is part of occurrence to be discussed in the next section (2.7 Offering). However, to present a complete pricing procedure, this section briefly discusses the general practice.

The time between initial price range confirmed and final offer price fixed is the time for a one to two week road show (Arthur Andersen, 1995). The final offer price is usually fixed by the underwriter and the company on the morning of the offering day (the first trading day) or after the market closes the day before the offering. Underwriting agreement is signed at the same time when offer price is fixed. In our example it is Day 63 after the market closes, or Day 64 before the market opens. Once the price is set, no further adjustments are allowed.

The negotiation and final determination of final offer price are influenced by a variety of company-specific and market factors, and it is especially affected by demand on the new issue (Buckland, 1995). These factors include (1) the company's past and present performance; (2) general equity market conditions; (3) the price and demand for other similar IPO issues at the time of effectiveness; (4) indications of interest (demand) the underwriters received during road show; (5) quality and level of demand from wide variety of investors including geographic diversity if it is a global offer; (6) US and global interest rate environment and overall economy; (7) success in marketing efforts; and (8) underwriters' allocation methodology.

The filing range is just an indication to the market of where the lead manager intends to price the transaction. The majority of IPOs are priced within the initial price range (Salomon Brothers, 1996). However, there are exceptions where prices are set either above the range (where there is an extraordinary demand), or below the range (where demand is insufficient at the proposed valuation level) (Lehman Brothers, 1996). In our data sample of 531 IPOs, about 60 IPOs' offer prices are above the high-end of the range. For these issues, underpricing on average is 32% (almost doubling the whole sample's underpricing) of which 10 issues' underpricing exceeds 50% and the most underpriced issue goes as high as 92%.

Since market condition is generally taken into consideration by most investment bankers at pricing, this dissertation takes the approach of net underpricing which excludes the overall market movement during the road show period. In calculating net underpricing from raw underpricing, in Chapter 8 the author applies the procedure of market adjustment which is measured by Dow Jones Industrial Average (day closing) from red herring dates to offer dates.

### 2.6.7 General Practice in Setting Number of Shares and Offering Price

Offering price and the number of shares offered are two interrelated factors. Once the offering size is determined by the valuation results, the decisions on the offering price and the number of shares offered will naturally follow the market practice in Wall Street. In other words, the two factors are affected and decided by each other.

Generally agreed upon number of shares for a first offering is 300,000 to 350,000 for minimum, and 400,000 or more for more desirable result. It is believed that any numbers less than 300,000 shares will make it difficult for both establishing a broad distribution and supporting an active trading market (CS First Boston, 1992). While in Ernst & Young's opinion, it is suggested that a minimum of 800,000 to 1,000,000 shares is necessary to support a active trading in the aftermarket (Ernst & Young, 1993).

As for offer price level, in general, stock priced below $10 is not viewed as a quality stock and below $5, often referred as 'penny stocks', is often a psychological break-point below which many investment bankers and investors lose interest (Securities Enforcement Remedies and Penny Stock Reform Act of 1990; SEC Securities Exchange Release No. 30-608) . Many large investment banking firms and investors are not interested in dealing with securities offered at less than $10. On the contrary, if the initial offering price is set too high, the number of shares issued will have to be reduced.

Consequently, the issue may have a poor reception, potentially restricting the stock's liquidity and hindering trading activity in the aftermarket.

Major bracket underwriters generally prefer a price range of US$10 to $20 per share (Price Waterhouse, 1993). A stock price in the $10-$20 price range is the most attractive range for both institutional and individual investors, and $20 or more (but not over $30) is more likely to show a prestige image (CS First Boston, 1992). While according to Ernst & Young, many consider the ideal range is between $5 and $20 per share, depending on the industry. Stocks priced at $1 or less are referred as high risk offering (Ernst & Young, 1993). As a matter of fact, the majority of IPOs have offering prices between $10 and $20 per share. According to my data sample of 531 IPOs, the average of IPO price in the United States in the period 1988-1993 is $10.36. Properly priced IPO is believed to go up in price in the immediate aftermarket and continue to rise over time as the company's earnings grow.

## 2.7. Offering

### 2.7.1. Effectiveness of the Registration Statement

Normally the company and the managing underwriter will request the SEC to declare the registration statement effective on a specified date. The SEC must be advised no later than the second business day before the day on which the registration statement is to become effective. In our example, we will assume that the registration statement is declared effective on Day 63, two days after the final amendment is filed. Once registration statement becomes effective, the security continues to be offered and actual sales commences. Written offers must take the form of the final prospectus (Securities Act of 1933, Section 5).

The registration statement may be declared effective by the SEC under either circumstances: (1) pricing information has been furnished, or (2) such information has been left out.

**a. Pricing Information Available**

Normally, when all parties involved, mainly the issuer and underwriters, think the registration statement is well in shape and an offer price is agreed upon, pricing information will then be printed in the final prospectus and filed with the SEC. In this case, the registration statement contains the pricing information when the declaration of its effectiveness is made by the SEC. This is a more direct and simple situation.

**b. Pricing Information Omitted: Post-Effective Amendment Required**

For IPOs filed under SEC Rule 430A, price information can be omitted from the registration statement when it is declared effective. If the registration statement has omitted pricing information, the price information must be filed in a supplemental prospectus no later than the second business day following the offering price is finalized or the date the prospectus containing the pricing information is first used (General Regulation under Securities Act of 1933, Rule 424 (b)(1)).

Filing the pricing information in the post-effective amendment is a burdensome procedure. This is because the post-effective amendment must be declared effective by the SEC before confirmations of sales can be made. Moreover, either an increase or decrease in the offering price or the number of shares offered beyond the estimate contained in the registration statement would materially change the disclosures contained in the registration statement which is declared effective. Consequently, the post-effective amendment must be filed and may require re-circulation of a revised prospectus to prospective investors.

### 2.7.2. Finalizing the Offering Price

Factors that determine the final offer price of a new security are the result of the pre-marketing efforts by the underwriters and their sales personnel,

and the market conditions as well as demand prevailing on the offering day.

**a. Results of Pre-Marketing Efforts**

Through pre-marketing efforts, the underwriters and their sales personnel collect nonbinding indications of interest (demand). Such demand information and quality of demand will not only affect the final price but also underwriters' exercise of considerable discretion in allocating issues.

**b. Market Condition on the Offering (First Trading) Day**

During the preliminary price negotiation which is a few weeks prior to the effective date, underwriters may indicate one price but reserve the final price. Because the prevailing conditions might be changed on the offering date and so will have the final price. The final price is usually set on the morning of the offering day or after the market closes the day before the offering. Once the price is set, no further adjustments are allowed.

An important measure of success in an IPO is the issuing company's ability to obtain a price within or above the initial filing price range. Consensus must be reached among the entire underwriting group in final offer price determination in order to make an underwriter syndicate to work.

### 2.7.3. Signing Underwriting Agreement

The binding firm underwriting agreement is normally not signed until 24 hours of the expected effective date of the registration statement, often on the morning of the offering day. Although substantial expenses will occur throughout the process of preparing the registration statement and during the waiting period, it is uncertain whether the offering will take place, especially in the best efforts underwriting agreement. Nonetheless, it is rare for a reputable underwriter to refuse to complete the offering once preparation of the registration statement has begun.

The underwriting agreement is executed by the issuer and the managing underwriter who acts on behalf of the underwriting group. The managing

underwriters will assemble a syndicate of underwriters that will commit to purchase all of the securities being offered at a fixed price, based upon information about market conditions and demand for the issuer's securities gathered during the period of road show. This commitment will be expressed in the underwriting agreement between the issuer and the underwriters. In the agreement, the issuer will make various representations about itself, its business and its offering documents, and the underwriters will commit to purchase the entire offering, subject to the satisfaction of various conditions (Coopers & Lybrand, 1995).

However, there are occasions where adverse market developments occur during the waiting period, particularly for small and highly speculative offerings, the issue will either come to the market at a price below the originally aimed, or it must be postponed until conditions improve.

### 2.7.4. Allocation, Confirmation of Sales and Final Prospectus

Typically, following the close of the market before the first trading day, the company and the managing underwriter agree upon the number of shares and the final price, namely price to public including underwriting discounts and dealers' concessions and re-allowances. This price should be consistent with the price indicated in the registration statement at the time it became effective.

Two major events take place right after the moment when the final price is fixed and the underwriting agreement is executed.

**a. Confirmation of Sales**

During the pre-marketing period, the sales personnel keep close track of the indications of interest. Immediately after the underwriting agreement is signed, the sales personnel orally confirm to their customers that the offering is effective. The salespersons will begin making telephone calls to confirm allocations and final sales. Much of this takes place in the morning of the offering day following the signing of the underwriting agreement.

In case of oversubscription, allocation is needed. Allocation may not be proportioned based on the original orders. The good allocation method is to ensure that investors appetite is not completely satisfied. Other consideration for allocation is that shares should be placed primarily to long-term investors and give priority to investors who have indicated an intention to buy in the aftermarket (Lehman Brothers, 1996).

**b. Final Prospectus**

Simultaneously, the company counsel and the underwriters complete the final prospectus by inserting the final pricing information and arranging the printing of the quantity of prospectus required by the underwriters.

Prospectuses are made available to the underwriters so that the underwriters may, promptly after the salespersons confirm the sales with investors, send written confirmations of the sales with a copy of the final prospectus to each investor. The sales confirmations may not be sent unless they are accompanied or preceded by the final prospectus (Securities Exchange Act, Rule 15c 2-8; General Regulation under Securities Act of 1933, Rule 460).

However, in much more typical situation, the final prospectus by mailing arrives much too late to aid in investors' decision whether to buy the IPO security. In order to counteract this, the SEC has undertaken certain steps to insure that a final prospectus will be sent in advance of the confirmation to those indicating an interest during the pre-marketing period.

**c. Rescission of the Sale**

Confirmations customarily call for payment of the purchase price of the security by the investors on the fourth business day following the execution of the underwriting agreement. There is nothing in the 1933 Act that gives a purchaser a right to change his mind after reading the final prospectus.

However, if the investor finds from the final prospectus that an oral statement made by salesman was false or misleading, the investor can rescind his

purchase commitment under Section 12(2) of the Act. Section 12 of the Securities Act permits rescission where there has been an oral misrepresentation. Such rejection appears to be infrequent and, in any event, creates a problem not for the issuer, but only for the selling underwriter, who must now find a new purchaser for the rejected security.

### 2.7.5. Free Writing after Effective Date

After the registration statement becomes effective, supplemental selling literature "free writing" may be distributed. The supplemental selling literature does not have to comply the format and other requirements required for a prospectus. However, the antifraud rules require that information contained in the literature be true and not misleading.

## 2.8. First Day Trading

### 2.8.1. Commencement of Trading

The first trading takes place in the open market on the offering day, Day 64 in our example. Usually, the first trading commences 30 minutes after the market opens. The underwriters now can trade the new issue in the market. The underwrite may exercise after-market price support shortly after the first trade if speculators jump on the issue hoping to "flip" it or turn it around and sell their originally subscribed new issue stock quickly at a profit. If too many investors sell their shares and flood the market, the stock's price may fall below the offering price. To counter this problem, the major-bracket underwriter who usually have the financial resources will buy the stock and, if necessary, hold it until the stock's price recovers (Price Waterhouse, 1993).

However, underwriter's price support cannot continue to raise price. Normally, the trading of IPO on the first trading day is active and trading volume is high. Nonetheless, the market is sophisticated enough to adjust any overvaluation soon. So the closing price of the first trading day is a good index to

illustrate underpricing, and such concept will be applied to the model developed in Chapter 6.

### 2.8.2. Stabilization

In general, broker-dealers strictly adhere to rules and, seek to place shares with investors whom they expect will hold the IPO shares for substantial period of time. However, there is no legal or regulatory statues that prohibits investors from selling shares purchased in an initial public offering into the secondary trading market. As matter of a fact, these trades may be made as early as the beginning of the first trading day following the signing of the underwriting agreement.

The underwriters can suffer serious losses if many of the initial investors of the IPO shares immediately resell into the market. In order to facilitate the distribution, the underwriters wish to maintain the trading market at a price no lower than the initial public offering price and, and as permitted by rules established by the SEC (15 US Code §10(b); 17 Code of Federal Regulations §240.10b-7), they place stabilizing bids to achieve this goal. Consequently, the shares sold back into the market immediately after the offering may have to be purchased by the underwriters' pursuant to the stabilizing bid. If the market is well above the stabilizing bid, disruptive fluctuations may occur in the trading market for the security offered.

Stabilization is accomplished when the underwriter of an offer enters a syndicated bid by submitting the bid with the specialist for an exchange-listed stock, or enters a bid on NASDAQ for an over-the-counter stock. In the case of IPOs, where there is no existing market for the security, the only limitation on the initial stabilizing bid is that it cannot exceed either the offer price (17 Codes of Federal Regulations §240.10b-7(j)(l)) or the bid of the highest independent dealer. The priority on a stabilizing bid is given to independent bids at the same price.

Once a stabilizing bid is entered, it may be maintained or reduced at any time. The stabilizing bid may only be raised if the stabilizer has made no purchases for three consecutive business days. If selling pressure is large enough to prevent buying the security at the issue price, the underwriter may either decrease its bid to lower levels or cease its efforts at stabilization altogether.

There is no time limit to stabilization. Given the fact that stabilization is capital-intensive, the underwriters can engage in stabilization for only a short period of time. Some practicing underwriters claim that stabilization seldom continues for more than two to four days (Bloch, 1989), while others say it can last for one week (maximum four weeks) (Lehman Brothers, 1996).

### 2.8.3. Legal Ground for Underwriter Price Support

The SEC generally prohibits security price manipulation, but it permits price support on the grounds that it mitigates, smoothes, and avoids short-run price decline at the time of distribution (15 US Code §10(b); 17 Code of Federal Regulations §240.10b-7).

Based on a 1940 SEC release (Securities Exchange Act Release No.2446), stabilization is "the buying of a security for the limited purpose of preventing or retarding a decline in its open market price in order to facilitate its distribution to the public.

Rule 10b-7 adopted by the SEC in 1955 (17 Code of Federal Regulations §240.10b-7) sets forth the guidelines regulating the stabilization activities by underwriters of an offering at the time of distribution. Rule 10b-7 requires that the intent of the underwriter and syndicate to stabilize the issue be disclosed in the prospectus.

Some agreements among the underwriters permit the managing underwriter to charge a fee to a participating underwriter. This is because if

the managing underwriter purchases such securities because they were not effectively placed for investment by the underwriter. Such agreements can cause the underwriters to repurchase securities from the managing underwriter.

In spite of these previsions and attempts by the underwrites to place securities in stable hands, it is not uncommon that shares placed in an initial public offering are sold back into a rising secondary market.

### 2.8.4 Over-allotment Provision (Green Shoe)

In pre-marketing efforts, sales personnel of the underwriter syndicate collect the information on prospective investors' indications of interest in the new issue. Using such information, the underwriters will allocate the shares in the case of over-subscription. SEC rules permit underwriters to offer and sell to the public more shares than they contractually are obliged to buy, and often Green Shoe option is granted to underwriters under underwriting agreement. The Green Shoe option is so called because the first instance involved the Green Shoe Company. The underwriter may take advantage of this provision to stimulate demand in the after-market or to help maintain an orderly market for a hot stock. The over-allotment option allows the underwriters to aggressively market the issue to achieve a successful offering.

If the demand for a new issue excesses the supply, the underwriters ration the shares. Over-allotments arise when new securities are over subscribed so that the underwrites sell shares in excess of the number of shares stated on the cover of the prospectus. This means that the underwriters must deliver more shares to investors than they would receive at the closing under the underwriting agreement, if there were not Green Shoe option.

To stimulate demand, the underwriters sell shares directly to investors. To cover the short sale, the underwriters enter a bid to buy the stock in the after-market, which helps support the price. To help maintain an orderly market, the underwriters are allowed to buy from the issuer a set number of

additional shares at the offering price, solely for covering overallotments. There is no legal or regulatory statues that limit the size of the Green Shoe option. However, the size of Green Shoe Option is restricted by the rules of NASD to 15% of the offering for firm commitment securities (NASD Manual (CCH), ¶2151.02). The Green Shoe option must be exercised within 30 days of the effective date. Thus, this additional supply of stock can help unsatisfied demand from causing a "run up" of the stock. Within the time frame, the underwriters are also allowed to buy shares from selling shareholders solely for the purpose of covering overallotment.

If supply of new securities excesses demand, the underwriters pay the issuing company for the surplus shares and disposes them later at market price. If the underwriters over-allot, they will have a short position, which may help to establish a better aftermarket for the shares following the offering. This is because many shares resold by original investors will have been placed effectively in advance through the over-allotment sales.

Over-allotment option has several benefits for the underwriters and some direct and indirect benefits for the issuing company. The underwriters and company benefit from being able to respond to last minute demand for the stock during the offering period. The company is able to issue more stock, which is often desirable from the company's standpoint, and the underwriters receive additional underwriting commissions. The underwriters gain additional flexibility by being able to call upon over-allotment option in part to cover any short positions established.

Often over-allotment option is exercised very soon after the commencement of the offering so that the closing occurs simultaneously with the first closing on Day 70. On occasions, the underwriters do not give notice of their exercise of over-allotment option until after the first closing, which obviously calls for a second closing with the attendant expenses for the company in terms of legal and similar costs.

### 2.8.5. Underwriter Prohibited to Sell at Premium

The underwriters are obligated by the rules of the SEC and of the NASD to make a bona fide offer of the security at the public offering price stated in the prospectus.

It is a serious offense for an underwriter to attempt to take advantage of a rising price in an initial public offering by directly or indirectly selling part of its underwriting allotment at a price above the offering price specified in the prospectus. If a security in a public offering trades at a premium in the secondary market, which in this example would begins on the day following the signing the underwriting agreement, the security could be prevented for sales and withheld security for future sales under NASD's complex rules. NASD rules can also restrict sales to a broad class of persons, such as those in the brokerage business, attorneys and accountants having relations with the managing underwriter, persons in the securities departments of financial institutions including their families. This is because professionals involved could take advantage of the rapid rise that sometimes occurs following an initial public offering.

## 2.9. Closing

IPOs are concluded on closing dates (Day 70 in our example). The closing date is generally specified in the underwriting agreement, and it is usually seven days after the effective date, but no later than 14 days of the effective date (Coopers & Lybrand, 1995). On the closing date, company executives, the managing underwriter and others meet and exchange all the legal documents. The stock certificates go to the underwriters, the accountants deliver their final comfort letter to the underwriters and, most important, the company receives its check for the proceeds from managing underwriter.

### 2.9.1. Payment

According to the timetable set in 2.2.2., if the final amendment (the second amendment in our example), is filed on Day 61 and the registration statement becomes effective on Day 63, the underwriting agreement might be signed in the afternoon of Day 63 after the market is closed or in the morning of Day 64 before the market is open. Confirmations accompanied by the final prospectuses (dated Day 63) are sent out to the investors on Day 64.

The confirmation of sales customarily calls for payment of the purchase price of the security by the customer on the fourth business day (sixth calendar day) after the underwriting agreement is executed and the offering day or first trading day, which would mean that investors' payment would be due on Day 69.

There is significant difference between the US and UK payment system. In the US, investors do not have to pay IPOs until the fourth business day of the first trading, while in the UK applications for IPOs must be accompanied by payment for the full amount.

### 2.9.2. Check to the Issuer

When each of the underwriters in the syndicate group has collected funds from their customers, the funds are transmitted to a central account under the control of the managing underwriter. If all payments by investors have been duly sent to this centralized account, an amount equal to the total price to public of the offering will be in the account on the closing date (Coopers & Lybrand, 1993).

At the closing on Day 70, the fifth business day following the execution of the underwriting agreement, the managing underwriter will arrive at the closing with a check in a clearing house funds (or having given tentative instruction for a bank wire transfer) in the amount of the aggregate public offering price less underwriters' discounts and commissions. When all

documentation is found to be satisfactory, the managing underwriter delivers the check to the company (or releases the bank wire transfer to the company's bank) against delivery of the security.

It is the custom in the New York securities markets that all transfers are made in "next day funds" which normally means that the funds are not available for investment by the issuer until the day following the closing.

### 2.9.3. Delivery of the Security

The security in the form of stock certificates is generally not physically delivered in the closing room. Instead, such delivery is made at the office of the issuer's transfer agent or, if American Depository Receipts are being issued, the Depository. The company instructs its transfer agent by telephone (or in the case of American Depository Receipts, the Depository bank) to deliver the security to representatives of the underwriters who are present at the securities window of the transfer agent or Depository bank (Coopers & Lybrand, 1993). Normally the managing underwriter will provide to the transfer agent or Depository bank a list of the names in which the certificates should be registered and the respective denominations.

### 2.9.4. Default Provision

Defaults by underwriters are extremely rare in which a substantial managing underwriter has permitted a transaction to collapse or lose on only a partial basis by reason of a defaulting underwriter. Normally, the managing underwriter knows this well in advance of the closing and will have made arrangements to spread the obligation of the defaulting underwriter among the remaining underwriters or to locate a new underwriter to replace the defaulting underwriter. All of the major underwriters are so highly capitalized and there are very few issues that could not easily be accommodated by the managing underwriter in the event of a default.

## 2.10. The Institutional Framework of IPOs in the UK

This dissertation is concentrated on the study of IPOs in the United States. However, considering the fact the London Stock Exchange (LSE) is one of the largest stock exchanges in the world, with its listed stocks outnumbering any of the other stock exchanges and payment methods practiced are different from that found in the US, the following presents a brief outline of the institutional details of the UK system as a contrast to the US system.

### 2.10.1. Methods of Listing Contrast to the US System

#### a. Capitalization

The London Stock Exchange rules that expected aggregate market value of all securities to be listed must be at least £700,000 for shares except where securities of the same class are already listed (LSE, 1995).

#### b. Requirements on Public Held Shares

LSE designates a minimum proportion of shares (25%) to be held by the public. The public defined by LSE (LSE, 1995) exclude directors of the issuer, persons connected with directors, pension fund established for the benefit of any directors or any person who is interested in 5% or more of the shares of the relevant class.

There are several choices for a company interested in being admitted to the London Stock Exchange either the official listing or unlisted securities, namely (1) introduction, (2) placing, (3) offer for sale by subscription, (4) offer for sale by tender and (5) offer for sale at fixed price (Levis, 1993). The last one is the most popular for the majority of companies admitted to the London Stock Exchange in recent years (Levis, 1993).

### 2.10.2. Pricing

In an offer for sale, the issuing house (principal underwriter) fixes a

price for the issue two weeks prior to the issue being traded when the potential demand for the new issue is unknown. After the price is fixed, the underwriter starts to distribute the shares at this price. Once the price of the issue is fixed, it can neither be changed in response to emerging demand not can it be withdrawn. The fixed price policy is designed to widen the new issue's appeal to investors and eliminate the price uncertainty existed in tender offer (Levis, 1993).

### 2.10.3. Underwriting

While applications for the issue at a fixed price are invited from the general public, the issue is sub-underwritten, at the same price, by a group of financial institutions.

**a. Underwriting Fee**

The fees charged by the sub-underwriters are related to the size of the issue. The issuing house charges commission to about 2 percent of the gross value of the issue.

Of the 2 percent, 1.25 percent is paid to the institutions which sub-underwrite the issue, and 0.25 percent is paid to the broker who arranges the sub-underwriting and puts his seal of approval to the issue. The remaining 0.5 percent is retained by the issuing house, which usually acts as the principal underwriter.

**b. Allocation of Shares**

If the new share is over-subscribed, the issuing house can exercise discretion as to the method of allocation of shares, using either a ballot or and scaling down of applications. Sometimes, the issuing house may even adopt a combination of balloting and scaling down for allocating the limited amount of new shares.

***Ballot***

The allocation reflects the underwriter's preference regarding the profile

of the firm's new shareholders, small individual investors versus financial institutions.

In a ballot, shares are allocated to a relatively small number of applicants selected by some number of shares, not necessarily the amount of shares applied for. Thus a ballot is biased against smaller investors. As a result, a large number of small investors may fail to acquire any shares at all.

*Scaling Down*

On the other hand, scaling down of applications offers a wider allocation of shares per individual investor. Applicants receive a certain amount of the over-subscribed stock, maybe only a fraction of the amount they applied for. The degree and method of scaling down is entirely at the discretion of the issuing house.

### 2.10.4. Settlement

#### a. Closing Day

The closing day for applications is usually seven days prior to the first day of trading which is totally different from the practice in the United States where closing day is five days after the first day of trading.

#### b. Method of Payment

Applications for shares must be accompanied by payment for the full amount. If payment is received in full for an application which is partially fulfilled under the circumstance of oversubscription, a check for the difference between the amount applied and the amount allocated is posted to the applicant one day before the first trading day. It normally takes 2-3 days for such checks to be processed through the regular banking clearing system.

To finance his application, an investor may use excess cash. In this situation, he will loss interest earned in a deposit account. Or he may borrow the whole or part of the required funds and pay interest charges.

In either case, the financing of the application for new issues carries a certain cost. The cost depends on the monetary size of the application, the daily interest rate and the number of days that the funds are needed.

## 2.11. Conclusion

This chapter discussed the normal procedure of IPOs in the United States. The discussion provides a background for in-depth analysis of the phenomenon of IPO underpricing in later chapters. To sum up the above discussion, it is clear that IPO price determination is directly affected by regulations. Within the institutional framework, IPO pricing scheme is developed through three prices. Regulations imposed by the SEC strictly regulates the time and type of price information that can be disclosed to the public. This notion will be further elaborated in later chapters and be applied to the model development.

**a. Initial filing price disclosed at red herring**

A high-low initial filing price range of the offering must be determined and filed with the SEC in the first amendment (preliminary or red herring prospectus) or no later than final amendment (final prospectus). Maximum price (high end of the range) must be determined when the first amendment is submitted to the SEC in order to calculate the submission fee. In general practice, a mean filing price is determined in red herring through a negotiation process in reference to the valuation results. Therefore, mean filing price can serve as a benchmark of initial filing price.

**b. Final offer price is determined at the effectiveness of registration statement.**

The final price is usually set in the morning of the offering day or after the market closes the day before the offering. Once the final price is set, no further adjustment are allowed. The SEC normally declares the registration statement effective one day before trading. Final offer price is usually

furnished when the registration statement with the SEC is declared effective. At this time final offer price is agreed upon and printed in the final prospectus and filed with the SEC.

**c. First trading day closing price**

Once the new IPO starts to be traded, selling and buying activities begin. Depending on the trading activities, IPO price fluctuates. By the end of the first trading day, the new IPO most likely has a new price tag which is different from the previous two, namely the price printed on the red herring and the offer price specified at final prospectus and underwriting agreement.

In conclusion, for one IPO three different prices may be observed at individual times. In the model developed in this dissertation, the three prices from the institutional procedures namely mean initial filing price, final offer price and the first trading day price will be used to illustrate the three concepts of IPO underpricing, namely *UFM*, *UTF* and *UTM*.

**Note:**

Association of the Bar of City of New York. (1977). Report by Special Committee on Lawyers' Role in Securities Transactions. Business Law, 32, 1879, 1891-98

Arthur Anderson. (1995). Securities Offering in the United States. (Manual for clients).

Bank of England. (May, 1990). New Equity Issues in the UK. Bank of England Quarterly Bulletin, 243-252.

Buckland, R. (1995). Efficient Pricing of New Equity Issues. International Small Business Journal, 14, 1, 65-85.

Coopers & Lybrand. (1995). Listing and Offering Equity Securities in the United States. (manual for clients).

CS First Boston. (1992). Handout re CBA IPO. (manual for clients).

Ernst & Young. (1993). Deciding to Go Public. (manual for clients).

Hongkong Shanghai Banking Corporation. (1994). (Manual to Clients).

Ibbotson, R. et al. (1988). Initial Public Offering. Journal of Applied Corporate Finance. 1, 37-45.

Johnson, C. (1991). Corporate Finance and the Securities Laws. New Jersey:Prentice Hall Law & Business.

Lehman Brothers. (1996). Letter to Client.

Lehman Brothers. (1996). Marketing, Bookbuilding, Pricing, Allocation and Valuation. (Manual to Clients).

Levis, M. (1993). The long-run performance of initial public offering: the UK experience 1980-1988. Financial Management. 22, 28-41.

Linklaters & Paines. (1996). US Registered Offerings. (Letter to Client).

London Stock Exchange (1995). Listing Rules.

New York Stock Exchange Guide, ¶24954A-2495E.

Price Waterhouse. (1993). The Going Public Handbook. (Manual for Clients).

Regulation S-X

Regulation S-K

Regulation F-1

Salomon Brothers. (1996). Handout for PRC Clients.

Salomon Brothers. (1994). Accessing the US Equity Capital Markets.

Samuel Montagu. (1995). Going Public. (Manual to Clients).

Schneider, C. (1972). Nits, Grits and Soft Information in SEC Filings. University of Pennsylvania University Law Review, 121, 254.

Securities Act of 1933

Securities Exchange Act of 1934

Securities Exchange Act Release No.2446, March 18, 1940

Securities Enforcement Remedies and Penny Stock Reform Act of 1990

SEC Securities Act Release No. 6383, March 16, 1982

SEC Securities Act Release Nos. 6331-38, August 6, 1981

SEC Securities Act Release No. 6949, July 30, 1992

SEC Securities Act Release No. 6950, July 30, 1992

SEC Securities Act Release No. 5009, October 7, 1969;

SEC Securities Act Release No. 4697, May 28, 1964;

SEC Securities Act Release No. 3844, October 8, 1967

SEC Securities Act Release No. 30-608, April 20, 1992.

SEC New Digest, November 17, 1980

15 US Codes, 1988.

17 Codes of Federal Regulation, 1991

## Chapter Three

## Review of Existing Theoretical Models of IPO Underpricing

Numerous studies have revealed that initial public offerings (IPOs) are significantly underpriced on average. The levels of magnitude of IPO Underpricing reported in various studies range from 6 to 20 percent in the developed markets, and as high as 100 percent or more in the emerging markets.

To solve the puzzle of IPO underpricing, academies have envisioned a considerable number of models. Some of these academic works theorize the occurrence of IPO underpricing as a consequence of informational asymmetries existing among the three major participants of IPO process. More specifically, investor, issuing firm and underwriter each processes distinct pieces of information upon which IPOs' values are judged, and upon which each of the three is motivated to work toward maximizing his own benefits. To overcome the informational asymmetries, the existing models, in common, designate one of the three parties - investor, issuing firm and underwriters - as a decision maker and his information variables (or decision making variable) as key factors to realize the IPO price optimization.

### 3.1. Investors: The Principal Decision Maker of IPO Pricing

#### 3.1.1. Underpricing as Compensation to the Uninformed - Rock Model (1986)

Rock model is generally considered a leading model in the literature of IPO underpricing, and is probably the most frequently cited. Many models developed later attribute their development to the inspiration of Rock model. In Rock model, investors, especially uninformed investors, are believed to be the main cause resulting in the undervaluing of IPO initial price.

**a. Two Types of Investors as a Result of Informational Asymmetry**

Based upon the amount of information that they possess in regard to new issues, Rock divides investors into two groups: the informed and uninformed.

***Informed Investors***

Informed investors are likely to be asymmetrically well informed about factors of issuing firms. They may have superior information about issuing firms' competitors. They may also have private information about certain characteristics of issuing firms that these firms cannot convey credibly, for example the quality of its management.

***Uninformed Investors***

According to Rock, the uninformed cannot predict the size of their order upon the realized value per share. When uninformed investors decide to invest a fraction of their wealth on a new issue, they base the decision upon their prior beliefs regarding the probability that their orders are filled. Uninformed investors calculate the fraction of their wealth by maximizing their expected utility of terminal wealth.

***Superior Knowledge Possessed by Informed Investors***

In Rock's view, informed investors combined posses more knowledge than both the issuer and underwriter. The issuing firm may know more than any single individual in the market, nonetheless, they know less than all the individuals in the market combined. Even underwriters' information and expertise are inferior to the pooled talents and knowledge of all investors. Issuers and their underwriters are at a considerable informational disadvantage relative to the market as a whole. Neither issuing firms nor their underwriters can know precisely what the market's valuation of their stocks will be.

**b. Underpricing Mechanism**

Rock attributes IPO returns required by uninformed investors as compensation for the risk of trading against superior information, and for

receiving a disproportional number of overpriced stocks.

When receiving an allocation, the uninformed consider the shares worth less than non-allocated shares. Because the uninformed compete with the informed, the issuer must ultimately compensate them for their disadvantage, and the shares must be priced at a discount to attract uninformed buyers.

Rock believes that underwriters have more discretion and they tend to favor their established customers who are usually better informed than the rest. Such arrangement increases the bias against the uninformed and leads to larger discounts.

However, when underwriters deny allocations to investors who in the past quickly sold their shares at a large gain in aftermarket, bias against the uninformed can be diminished and the size of the discount decreased. In such a situation, the uninformed can benefit from underwriters' discretionary power.

In a rationing situation, the value of the issue equals the value of the orders filled. The allocation causes the uninformed investors to revise downward their valuation of the new shares. Therefore, to attract uninformed investors to the offering, the issuer must price the shares at a discount.

**c. Nature of the Model: Equilibrium Model**

Rock model is basically an equilibrium model. To satisfy the description of the equilibrium, investors' confidence that they are dealing with a good/bad offer must equal the actual probabilities that they will get an allocation. In other words, the complete equilibrium is to match investors' expectations with the actual allocation probability.

Departing from the usual belief that the offer price is related to demand, Rock argues that as the total number of IPO orders increase when the uninformed try to take the advantage of lower price, the probability for them to get allocation declines. In other words, while orders by the uninformed may be stimulated by a decrease in the offer price, their probabilities of obtaining desirable shares are diminished. Therefore, the proportion in their portfolio

that the uninformed investors invest in new issues is determined not only by price but the probabilities that they can get allocation of underpriced shares.

### 3.1.2. Equilibrium Price Summarizes all Information- Grossman Model (1976)

#### a. Prices Affected by the Informed rather than Uninformed

Unlike Rock, Grossman contends that informed investors determine IPO prices rather than the uninformed. Informed investors are those who know new shares' underlying probability of generating a future price, and who take a position in the market based on this information. When all informed investors do this, current prices are affected.

Uninformed investors do not invest resources in collecting information, but they know that current prices reflect the knowledge of informed investors. By observing current price, the uninformed form their beliefs about the prospects of new issues.

#### b. Information Content: Price Reflecting Information of the Market

Grossman argues that prices transmit information. The competitive system aggregates all the market's information in such a way that the equilibrium price summarizes all the information in the market. Information is the true underlying probability which generates a future price.

An investor who invests nothing on information and observes the market price can achieve a utility as high as investors who pay for the information. Informationally efficient price systems aggregate diverse information perfectly. By doing so, the price system eliminates the incentive for collecting the information.

#### c. Underpricing Mechanism: Underpricing as Compensation for Collecting Information

If information is costly, there must be noise in the price system so that investors can earn a return on information gathering. If there is no noise

system and information collection is costly, then a perfect competitive market will break down because no equilibrium exists where information collectors earn a return on their information. If no one collects information then there is an incentive for a given individual to collect costly information because he does not affect the equilibrium price. When many individuals attempt to earn a return on information collection, the equilibrium price is affected and it perfectly aggregates their information. This provides an incentive for individuals to stop collecting information. Underpricing reflect the cost paid for collecting information.

### 3.1.3. Discussion

The assumptions of the models by Rock and Grossman are derived from the dependency upon the existence of the two groups of investors: the informed and uninformed. Both models assign unique investment behavior to each of the two groups defined. The foundation of such an assumption is difficult to reconcile because of the complexity of the real IPO world. There are many factors other than knowledge on new shares that determine investors' behavior.

#### a. Classification of Two Groups of Investors

The division of two groups of investors conflicts with some existing leading information theories.

According to Rogers' (1963) information diffusion theory, information is in a dynamic flow and no one can be informed at all time. There are always some who lead others in obtaining, accepting and disseminating new information. Those who accept new information before others become opinion leaders and are followed by others who accept the same piece of new information at a later time. When a certain piece of information is widely diffused, another group of opinion leaders emerges with possession of other new information.

Assuming there is a group of informed investors in the market, it is obvious that even within this group there are opinion leaders who have superior information about a new issue than the rest of the group even although such information may eventually disseminates to the rest of the informed. Considering the complexity of today's international and economic environments, it is difficult to envision the same group of investors as forever opinion leaders or informed investors. The constant change of the members within each designated group, coupled with investment capabilities determined by the wealth possessed by investors, makes it difficult to assign specific investment behaviors to investors based upon the knowledge possessed.

**b. Compensation to the Uninformed**

Rock proposes that there is an information asymmetry between informed and uninformed investors. He also assumes that when there is excess demand for shares, underwriters use rationing method rather than price adjustment. Under such a rationing situation, informed investors crowd out uninformed investors for allocations of profitable issues. The allocations received by uninformed investors are biased toward less-profitable issues. To induce uninformed investors to participate in the IPO market, the issuing firms must underprice their IPOs to compensate the uninformed for their participation.

Oversubscriptions are not necessarily from investors' expected allocation because there is a trade off between the costs of under-allotment and the riskless gains from fractional purchases of discounted IPOs. In most cases, the demand for IPOs is not for the security offered but for the discount (Buckland, 1995).

The reality of the IPO market is that IPOs are often over subscribed, and issuers' motivations to underprice to attract investors are not necessary. According to Benveniste and Spindt (1989), all of the firm-commitment IPOs placed by William Blair and Co. during a five-year period were oversubscribed in the premarketing period. The phenomenon is supported by the findings by Koh and Walter (1989). Through examining all new public issues that were

taken to the Singapore Stock Exchange from 1973 to 1987, they find that 90 percent of the IPOs were oversubscribed. In one of the studies by Ritter (1987), the researcher point out that due to the nature of the method, only 10 percent of firm commitment offers are not fully subscribed. While Ibbotson and Jaffe (1975) noticed that it is not uncommon for underwriters to receive indications of interest for five times the number of shares available.

**c. No Set Investment Patterns for Either the Informed or Uninformed**

Rock model neglects an important aspect of the IPO market that is investment behavior is not only affected by knowledge or information but restrained by institutional structure. For this reason, static behavior assigned to each group of investors in Rock model fails to reflect the reality of the IPO market.

***The Informed May Not Buy Underpriced Issue***

Personal experience gained from IPO transactions and knowledge obtained from the interviews with Wall Street practitioners all show that investment behaviors of both informed and uninformed, even if they can be classified so, can cross the line of investment patterns set by Rock model. It is not necessarily true that informed investors do not miss any underpriced issue. There is no evidence that the knowledge alone will guarantee the informed allocations on the issues they prefer.

(a) Restrains Set by Institutional Requirements

The informed are not allowed to purchase discounted new shares if the issues do not fall into their investment scopes. Informed investors, if they are investment funds, are ruled by their respective regulatory restrictions. International funds have to buy diversified foreign issues. Growth funds have to buy growth stocks. Professional funds are required to invest in the areas that meet their pre-set investment goals. China fund can not buy Japanese new stocks unless issuing firms have investment in China; Asian fund will not buy

South American new issues even though these funds might have superior information about these new stocks.

(b) Availability of Alternate Investment Vehicles

Decisions on whether to purchase underpriced issue are affected by the performance of alternate financial products and investment vehicles available at the time. One example of such alternate is risk free interest rate related products. Interest rate could affect investors' motivation to buy IPO shares. When interest rate remains high, informed investors may put large proportion of their wealth in money market thus showing less interests in new issue market. For informed investors, decisions on buying or not depend on the compared magnitude of gains acquired from underpriced issue and interests earned from the money market. At the time when junk bonds perform superior, the new issue market would appears less attractive to investors.

(c) Personal Factors

Personal influence of fund managers can affect informed investors' investment behavior greatly. Regular investors who often express interests in new securities may always rely on a few fund managers on decision making. It is possible that some fund managers put more trust in their personal friends who underwrite new issues, or they may be less confident in some other underwriters so that they do not buy underpriced issues from those particular underwriters.

(d) Unexpected Events

Other uncontrollable variables may affect informed investors' investment decision making. The informed may successfully project an overpriced new issue. However, with unexpected events such as outcome of presidential election or natural disasters, the new issue may become abnormal. As a result, the informed may lose a wining issue.

***The Informed May Buy Overpriced Issues***

Contrary to Rock model's assumption that information possessed by

informed investors will prevent them from purchasing overpriced IPOs, there are situations where the informed may buy overpriced issues for several reasons. First, they hope to maintain good relations with underwriters. Second, they hope to be compensated by getting allocations from underwriters in future underpriced new securities. Finally, particularly in emerging markets, purchases by institutional investors, mostly the informed, sometimes are driven by government policies. Governments require big institutions to buy overpriced issues to support their infant security market, such as the case of China.

***Uninformed Investors May Buy Underpriced Issues***

Rock proposes that chances for the uninformed to buy underpriced issues are slim because of their lack of information and the allocation discretion exercised by underwriters. This is not always true in the reality. Firstly, uninformed investors usually rely on their brokers on investment decisions. Brokers from large brokerage firms that dominate the security retail market, such as Merrill Lynch, have superior information on the market. Individual brokers who work on commission basis are motivated to help their clients in getting underpriced IPO shares. With the help of knowledgeable brokers, uninformed investors can invest as informed investors.

Secondly, many uninformed investors act as followers of institutional and regular investors. Although, they do not have time or sources to study new issues or market information, yet they follow informed investors religiously. If Fidelity Fund buys a particular new issue, some uninformed investors may buy the same issue. As the result, the uninformed may invest like the informed.

***Uninformed Investors May Be Phased out as a Result of Constant Failures***

Although Rock believes that issuers can compensate uninformed investors with underpriced issues to keep them in the IPO market, for the uninformed, losses from buying overpriced issues may be larger than gains from buying

underpriced issues. If uninformed investors act as described in Rock model and constantly buy overpriced issues, they will lose their capital and be eliminated from the new issue market. Options faced by uninformed investors can only be two: (1) turning into the informed by relying on brokers or simply acting as followers of institutional investor, and (2) leaving the new issue market for good.

**d. Insignificant Leverage of Control Variable**

The major optimal variable T in Rock model is the investment by the uninformed in IPO transactions as a proportion of their total investment. Yet, in general situation, T is very small, no larger than 1 percent. Except for a few hundreds of large funds, most investors only invest 100 to 1,000 shares per person. Even their aggregated purchases will not likely exceed a single fund's purchase. This reality makes the results of Rock model about the impact of the uninformed somewhat unrealistic.

## 3.2. Issuer: The Principal Determinant of IPO Pricing

The second group of models in discussion attributes issuers as primary decision makers of IPO pricing. The assumption is that when trying to acquire capital through selling equity, an issuer knows better than anyone else of the value of his firm and his goals of going public. Outside investors have little or limited information about the issuing firm's real value. As a result, there exists an informational asymmetry between the issuer and investors.

For investors, in order to pay a price for ownership in the firm, they will have to judge the firm's real value with their limited information about the firm. For the issuer, in order to persuade investors to buy his equity and maximize his expected utility, he will have to utilize the most effective signals to convince investors of his firms' value. The issuing firm has every incentive to communicate inside information about the firm value to investors.

Information that the issuer reveals to the public is a primary variable in the process of IPO price optimization which ultimately determines the degree of IPO underpricing. Theorists holding such a proposition believe that the degree of success that the issuing firm can effectively communicate insider information to investors has tremendous impact on initial IPO price.

### 3.2.1. Univariate Signaling Model

Before a new equity comes to the market, the quality of the equity is unobservable to investors. Unobservability of project quality leads to an asymmetric informational problem between the issuer and investors.

Mechanism needs to be established to overcome this information asymmetry. Otherwise, the asymmetric information between the issuing firm and investors about the value of new issues can result in adverse selection problem for the firm's security sale in the market

#### a. Fractional Holding by Issuer as a Signal - Leland and Pyle Model (1977)

Leland and Pyle model is one of the first signaling models conceived by academies to describe the issuer's function in the IPO process. Models developed afterwards are largely replicates or extensions of it.

Leland and Pyle confirm that the issuing firm's true quality is known only to the firm itself and outsiders know little or nothing about the issuing firm.

***Fractional holding of IPO as a signal***

Leland and Pyle suggest that the issuer could use his fractional holding of the firm's total issuing equity as a signal to outside investors about his expected future cash flows. By revealing a high fractional holding of the firm's equity, the issuer transmits his confidence to prospective investors and conveys an evidence of high quality of the firm.

Investors are expected to make their IPO purchasing decisions based upon this crucial information. The value of the firm perceived by investors increases as the number of shares held by the issuer grow.

*Underpricing mechanism*

In Leland and Pyle model, underpricing can be viewed as compensation to investors. If the market overvalues the firm's actual value, outside investors would on average receive less return required for the project's risk. If marketing evaluation consistently underestimates the firm's true value, outside investors can receive excessive returns.

*Nature of the model*

Leland and Pyle model is basically a model of capital structure and financial equilibrium with signaling schedule of an information variable of fractional holding.

**b. Auditor Chosen by the Issuer as a Signal - Carpenter and Strawser Model (1971) and Timan and Truman Model (1986)**

When a firm's owners decide to take their firm public, chances are that the firm's true value is imperfectly known by investors. In order to sell its shares, the firm must choose an auditor to examine the firm's financial information and to help in preparing the firm's financial statements that provide information to the market about the firm's value.

*Quality of the auditing firm as a signal*

It is believed that auditors offering service nationally or internationally are known for higher quality standards, especially the top six auditing firms, and owners with more favorable information will be willing to pay the fee of a more prestigious auditor since the information provided to investors by the auditor is likely to be favorable. In contrast, it will not be worthwhile for owners with less favorable information to pay the cost of a high quality auditor since the auditor's information is likely to be unfavorable.

*Carpenter and Strawser Model*

Carpenter and Strawser model (1971) assumes that choices on auditors may have an impact on the price at which the firm's shares are sold. The quality of auditor sends a valid signal to investors about the firm value. In order to receive a higher price for the shares sold, investment bankers always advise IPO firms to switch regional auditors to national ones.

*Titman and Truman Model*

Similarly, Titman and Truman (1986) suggest that the quality of auditor that a firm chooses greatly affects the price of an initial public offering.

In sum, both models assert that employing a more prestigious auditor provides a favorable signal to the market. The higher the quality level of auditors chosen, the greater will be investors' assessments of the firm's value. Owners with favorable information about their firm's value are more likely to chooses a higher-quality auditor than owners with less favorable information.

### 3.2.2. Bivariate Signaling Models: Extension of Univariate Signaling Models

While the model discussed in the previous section believe that the issuer needs only one signal to convey his true value to investors, the models to be discussed in this section contend that additional signals are needed to disclose the issuer's true value.

#### a. Underpricing as the Second Signal - Allen and Faulhaber Model (1989)

Allen and Faulhaber recognize the theory of Leland and Pyle that the best information about a firms' prospects is shown by the fraction of new equity held by the firm itself, and by revealing this information to investors in the financial market, a good firm signals his superior prospects to investors. However, one signal is not enough.

*Deliberate underpricing as a second signal*

In addition to shareholdings retained by the issuer, Allen and Faulhaber model assert that the issuer deliberately undervalues his IPO as a second signal to gesture his firm's high quality. Investors are compensated for taking such a signal and buying deliberately lower priced IPO.

Deliberately underpricing the firm's initial offering is a credible signal saying that the firm is a good one. Because only financially sound firms can be expected to recoup such losses in later years. High quality issuing firms offer to trade off a lower IPO price against a more favorable interpretation of future high dividends, and it is especially true when there is a plan for second offering.

*Low quality firms lack financial strength to mimic high quality firms*

In contrast, low quality firms are more reluctant to offer this trade off, since they are less likely to experience high future cash flows or less likely to pay high future dividends. Consequently, investors can rationally interpret future dividends more favorably for firms that underprice their IPOs.

*Nature of the model*

Allen and Faulhaber model is also an equilibrium signaling model. The model interprets IPO underpricing as an equilibrium signal of firm quality.

**b. Offering Price as the Second Signal- Grinblatt and Hwang Model (1989)**

Grinblatt and Hwang (1989) develop their model with the same assumption proposed by Leland and Pyle. Grinblatt and Hwang assume that the issuer has better information about his firm's future cash flows (an important indicator of the firm's value), while outside investors have only limited knowledge of such important indicator, if not at all. Grinblatt and Hwang model can be regarded as an extension of the model by Leland and Pyle (1977). Although methods are different, the ultimate goal of this model is in line with that of previous signaling models that is to reveal the quality of issuing firms.

***Expected return and variance must be signaled simultaneously.***

Different from the Leland and Pyle (1977) model, Grinblatt and Hwang believe that the issuer's fractional holding alone is not sufficient to signal his expected value. In their two parameter signaling model, there is an information asymmetry about the expected value and the variance of issuer's future project that is going to raise new capital. To overcome this asymmetric information problem, two signals are needed to communicate two pieces of information. The firm tries to gesture expected return and variance simultaneously.

According to Grinblatt and Hwang's derivation, the equilibrium signaling schedule is a function of two variables of (a) the issuer's fractional holding and (b) project variance.

***Second signal: Offer price to signal the project variance***

Owner's fractional holding in the firm serves as a signal of the firm's good quality. A second signal, the degree of underpricing, is needed to describe the project variance, and this signal is indirectly observed when the offering price of the IPO is publicly announced. The firm's intrinsic value is believed to be positively related to the degree how its new issue is underpriced. In other words, the degree of underpricing is positively related to the issuer's firm value.

The model concludes that issuers with higher variance will have higher expected value. Issuers with high value are more likely to be willing to pay additional cost for a second signal of underpricing at IPO.

In this model, IPO discounts by the issuer, in conjunction with the amount of equity retained by the issuer in the firm's portfolio, convey to investors the unobservable intrinsic value of the firm and the variance of its cash flows and signal the issuing firm's quality and value.

***Consistency with commonly agreed upon rationale for underpricing***

Grinblatt and Hwang model is consistent with the rationale for underpricing agreed upon by many investment professionals. More specifically, when

investors' interests are generated by a low-priced new issue, the actual IPO share price tends to be higher than if it has not been underpriced to begin with. Spread between the actual IPO price and initial price created by such a mechanism generates more underpricing.

**c. Disclosure as the Second Signal - Hughes Model (1986)**

Based on the univariate signaling model by Leland and Pyle (1977), Hughes model (1986) suggests that financial disclosure or an announcement by the issuing firm of its true value be another important signal.

Issuers of high-quality firms have incentives to develop mechanisms which will enable them to sell their IPOs at desired price. Through a direct financial statement or other forms of disclosure, the issuer credibly communicates inside information about the firm's value to investors. In Hughes' bivariate signaling model, IPO issuers make disclosures about their firm value to avoid market failure.

Direct disclosure by the issuer establishes a contingent contract between the issuing firm and investors. This disclosure is then verified by an investment banker who enters into a contingent contract with investors. Such a contract imposes a penalty if the ex-post observable cash flow indicates fraudulent disclosure. Under SEC's disclosure rule, both civil and criminal liabilities can result from material misrepresentations or omissions of information. It is the issuing firm and underwriters involved that are subject to liability under the Securities Act. SEC regulations prevent low quality firms from deliberately presenting false disclosures.

### 3.2.3. Equilibrium Model

**a. Three Equilibria in Two-Period Signaling Model:**

**Imitation Cost Issue - Welch Model (1989)**

This model formalizes the argument of "leaving good tastes in investor's mouth" (Ibbotson, 1975). In a two-period signaling model, Welch model

describes issuers as rational decision makers with superior information in a perfectly competitive capital market. The main argument is that low quality issuers must incur imitation costs to pretend to be high quality firms, and low quality issuers face a trade off of either possible lose if they are discovered or forgo the high price at IPO if imitation is not discovered.

There are three distinctive features of Welch model. First, the issuer's better knowledge about the firm's value results in an informational asymmetry between the issuer and investors. Secondly, high quality firms whose quality is not known by the market tend to underprice their shares. Thirdly, high quality firms use underpricing as a signaling device to attract investors.

***Pooling equilibrium***

Welch model (1989) presents three pure Equilibria of IPO issuing game and operating choice of issuers in different equilibrium. In the first equilibrium, a pooling equilibrium, investors cannot not distinguish between low quality and high quality issuers at the IPO. Pooling equilibrium presents a mixed status that both high quality and low quality firms tend to price IPO at the same level in which low quality firms imitate high quality firms and are not discovered. High quality firms receive less than their true value at the IPO. Yet investors get bargains in underpricing.

The possibility of obtaining higher price induce low-quality firms to imitate. When not discovered, there is an equilibrium in which both high and low quality firms pool and sell the same quantity in the first period. As a result, low quality firms may invest in imitation expenses but receive higher prices at the IPO. Or their imitation may be discovered during offerings, and they suffer substantial loss of their investment on imitation. In either case, low quality issuers face a trade off.

***First-best separating equilibrium***

In the second equilibrium, a first-best separating equilibrium or first best announcement equilibrium, all high quality firms operate but do not underprice,

and low quality firms voluntarily reveal their identities. This equilibrium occurs when the probability of detection is very high, and imitation by low quality firms is most likely to be discovered. As a result, high quality firms can sell their IPOs for the maximum price. In this equilibrium, low quality issuers prefer to reveal their true values.

***Signaling equilibrium or underpricing equilibrium***

In the third equilibrium, a signaling equilibrium or underpricing equilibrium, all high quality firms deliberately underprice their IPOs and operate, while low quality issuers disclose their identities by not operating. In this equilibrium high quality firms sell a fractional of their ownership for less than their market value and low quality firms reveal their true value. This separation is necessary, because marginal costs of underpricing is higher for low quality firms than for high quality firms. By imitation, low quality issuers face not only loss of firm value through underpricing but also the loss of imitation cost.

***Cost issue is the core of the Welch model***

In all of the three equilibria proposed by Welch, the center of the issue is cost involved in signaling or imitations. In the underpricing equilibrium case which is previously presented by models of Allen and Faulhaber and Grinblatt and Hwang, although underpricing can add sufficient signaling costs, yet for high quality issuers discounted IPOs will subsequently result in higher-priced shares. Cost of discount, therefore, is value enhancing for a good firm especially when there are secondary offers for issuing firms.

In the case of first-best separating equilibrium, since chances for imitations to be discovered are high, imitation costs are high. High costs help prevent low quality firms from imitation.

In the case of pooling equilibrium, there is a trade off for issuers' pricing policies. If low quality firms price their IPOs at the same level as high quality

firms, they will either suffer loss if their imitations are discovered or forgo high IPO prices if not discovered.

In conclusion, low quality issuing firms' pricing policies are likely affected by the comparisons of imitation costs and trade offs. High quality firms are more likely to use underpricing as signal because they can absorb discount costs incurred while low quality firms cannot.

**b. Pareto Optimal: Equilibrium in Two Trading Periods:**

**- Gale and Stiglitz Model (1989)**

Gale and Stiglitz model is a two stage pareto optimal equilibria model in which equity can be sold twice. Similar to the models by Leland and Pyle, Gale and Stiglitz model asserts that the proportion of IPO shares held by the issuer reveals more about the issuing firm's value.

It is assumed that once the good firm signals the fraction of his holding of the new share, investors should be willing to buy the remaining shares. It is possible that a low quality firm will pretend to be a good one by holding a large fraction of his equity at first period of time, then selling it in the aftermarket. Holding and selling at the aftermarket are equally costly. Consequently, the issuer's commitment of holding is dependent on both the absolute and relative holding costs.

There will be a pooling equilibrium in the first period, when uncertainty is small and holding is not very costly for low quality firms. Therefore, both high quality and low quality firms can afford to hold large fractions of their equity and produce a pooling equilibrium.

However, when uncertainty is large, the pooling equilibria pareto will be dominated by the separating equilibrium.

### 3.2.4. Discussion on the Signaling Models

**a. Rationale**

The models discussed in this section attempt to rationalize IPO

underpricing as a signaling equilibrium phenomenon. Signaling models are derived from the assumption that an informational asymmetry exists between issuers and investors when new shares are first offered. Theorists of signaling models argue that issuers have to take an action of observable financial disclosure to overcome the informational asymmetric problem.

A fundamental argument of these theorists is that high quality firms can afford to signal their quality by underpricing their IPOs, while low quality firms do not signal by underpricing their IPOs because they cannot recoup the costs of the signals. Therefore, investors can perceive issuers' selected financial signals as credible communication of internal information.

One common point of these models is that they all believe that underpricing is a signal saying the issuing firm is a good one. A successful IPO is described as such that a partial offering of stock is made initially, information is then revealed, and subsequently more stocks are sold. Low quality firms may send similar signals by imitating good firms, but they run the risk of being discovered and bearing a sufficiently large initial cost.

**b. Comparisons of the Models**

Leland and Pyle model (1977) is a static equilibrium model and a simple model of capital structure and financial equilibrium in which issuers' willingness to invest in their own stocks can serve as signals of project quality. The model implies that the information transferred through signaling possess is a key efficiency property of IPO process but such a notion lacks empirical support.

The models by Grinblatt and Hwang (1989), Welch (1989) and Allen and Faulhaber (1989) are basically further development of the model by Leland and Pyle (1977). All the three models assume that the management has information about firm value that can not be noiselessly revealed to the public, and all the three models imply that asymmetric information about firm value leads at least some firms to underprice their IPOs to signal their value. Such firms expect to

recoup the costs of underpricing by receiving a higher price for future second offerings.

In both Grinblatt and Hwang and Allen and Faulhaber models, IPO underpricing results in higher proceeds for high quality firms in future selling activity. However, Welch model focuses on financial market's ability to observe firms' past and current real activities at the IPO. It is assumed that there are direct costs that low quality firms must incur in order to imitate observable operations by high quality firms. Therefore, Welch model offers comparative static analysis which is more comprehensive than the models by Grinblatt and Hwang and Allen and Faulhaber.

In Grinblatt and Hwang model, underdiversification is combined with underpricing to signal both the mean and variance of returns while in both Grinblatt and Hwang model and Welch model firm type is fully revealed in some exogenous way. While in Allen and Faulhaber model, learning occurs as investors update their Bayesian prior on the basis of the firm's performance.

Hughes model (1986) partially addresses the question of efficient signaling by showing that issuers will select the least costly combination for two signals when there are two unknown parameters.

Titman and Truman model (1986) is an equilibrium model. After examining the quality of auditor of issuing firm's choice, the model reaches a signaling equilibrium in which optimal choice of auditor quality is determined. In such an equilibrium, the choice on auditor quality is made so as to maximize issuer's expected utility of terminated wealth. This model adds an important item to the menu of signals already available to investors.

To sum up, the models discussed in this section are built upon the assumption that an informational asymmetry exists between issuers and investors. Issuing firms are likely to be asymmetrically well informed about their own business' situation. This asymmetry can affect pricing because

issuers have an incentive to misrepresent themselves to potential investors as higher quality than they actually are.

**c. Limitations**

One major limitation of the signaling models in the discussion is that they are built on the hypothesis that conflicts with regulations and business practice. In general, issuing firms must hold over 50 percent of their equity for controlling purposes, and by the requirement of the stock exchange issuers must sell over 25 percent of the shares to the public. Restricted by such regulations, the range of equity offering to the public is limited to 26 to 49 percent. Thus, holdings by issuers for signaling are limited to the range of 51 to 74 percent. In most cases, equity held by IPO issuers is between 60 percent to 70 percent which makes not much difference for signaling.

Secondly, the signaling models in discussion are hypothetical, and key parameters of the models are not control variables in the IPO process.

Thirdly, since SEC executed more restricted monitoring policy and disclosure rules, the average quality of new issues are constantly improving. It is becoming more and more difficult for imitated issues referred in Welch model to go to the market yet undiscovered.

Fourthly, the models in discussion emphasize only one of the three key principals (issuer, investor and underwriter) and fail to present complete and logic theories.

Overall, all the signaling models in discussion lack empirical support. The motivation for all the signaling models is that the future benefit of IPO underpricing is greater than the immediate loss. This assumption, however, as it will be discussed in the next chapter, needs further empirical support. A later study by Ruud (1990) found the opposite evidence of such an assumption. For issuers with subsequent stock offering, even future benefit cannot cover the immediate loss.

### 3.3. Underwriters: the Key Decision Maker in IPO Pricing

Theoretically, underwriters' activities are ruled by regulatory environments and their marketing efforts are restrained by a variety of rules. For instance, in the United States underwriters are required by the SEC to offer a security to all investors at a uniformed price. In other countries, such as the UK and Singapore, underwriters are required to evenhand allocation of oversubscribed issues.

The models discussed in this section accredit underwriters as the most important decision maker in setting up IPO prices.

#### 3.3.1. Optimal Delegation Contract - Baron's Model (1982)

Baron's model is one the first that attributes IPO underpricing to underwriters. Baron's model is laid upon the assumptions that (1) there is an information asymmetry between an issuer of new security and an investment banker, and (2) the value of a new issue is affected by market demand and the investment banker's selling effort.

The investment banker's role in IPO is basically threefold: (1) underwriting, (2) advising the firm on pricing and (3) distributing the new issue stock.

In his model, Baron asserts that the banker's functions of advising and distribution make direct impact on the offer price to be set. Advisement from the investment banker provides the issuer with the information about the capital market demand. Because the banker is better informed than the issuer, the issuer depends on the banker to deal with the adverse problems resulting from the informational asymmetry. The investment banker conducts pre-selling activities to gauge more accurately the demand for the issue. Yet such information is not directly available to the issuer. The greater uncertainty of the issuer about the market's demand for the security being sold, the greater value the banker attributes to the issuer on delegating the offer price decision.

In the same function, at the time of distribution of the new share and when the issue starts to be traded, the banker can generate demand for the issue. For this reason, the banker is crucial to the issuer. In Baron's model, the issuer must compensate the banker for the use of his information, so the banker shares in the gains from his superior information. In other words, IPO prices are set to compensate investment bankers for using their information about market and distribution service. Such compensation is realized through the optimal contract which sets the issue's offering price below its "true value". The optimal contract is agreed between the issuer and investment banker, but price decision is made under the delegation of the investment banker.

### 3.3.2. Underwriter Compensating Investors for Revealing Information in Premarket - Benveniste and Spindt Model (1989)

In order to establish an appropriate price and allocation, underwriters need information on market demand that is investors' possible reaction to the new issue. Previous researchers believe that investors who possess positive information unknown to underwriters have no incentives to reveal them to underwriters thus forming an informational asymmetry between investors and underwriters. Benvenister and Spindt model (1989) describes a passage to overcome this asymmetry. The model believes that underwriters can reduce IPO underpricing by using their access to investors' collective information.

In Benveniste and Spindt model, the premarketing activity is described as an auction conducted by underwriters. As bidders, investors know that their indications of interest will affect the offer price and allocations they receive. When the information gathered during the premarketing period shows that there is a strong interest in the new issue, the final offer price may exceed the original filing price. However, if the demand is low, the offer price may decrease to below the expected value. The changes in the offer price between the original filing and the offer date are a result of bids solicited.

In this model, investors are motivated to truthfully reveal the level of demand because there is a pricing and allocation scheme that can maximize investors' total expected profit. As a common practice, underwriters often repeatedly sell IPOs to the same regular investors to reduce underpricing and increase efficiency of the capital acquisition process. Investors who are regularly given priority in IPO allocations by an investment banker earn abnormal returns. Such a relationship gives underwriters a leverage over their clients in the new issue market. Underwriters can use this leverage during the pre-selling period to induce regular investors to reveal their true intention, such as by threatening to reduce an investor's allocation priority in future. Investors who truthfully reveal good information must expect greater profits. Profits, in this case, are generated by a tradeoff between increased allocation and underpricing. The creators of this model believe that underpricing is a mutual consequence of such a premarket auction.

### 3.3.3. Allocation Mechanism Exercised by Underwriters:

**- Benveniste and Wihelm Model (1990)**

Benveniste and Wihelm model depicts the consequences of institutional constrains on underwriters' marketing efforts which in turn influence the decisions on offer price. In this model, investors are described as two different groups: regular investors and retail investors. Regular investors are institutional investors who repeatedly express interest in largest blocks of new shares, while retail investors are smaller investors who receive allocations through retail brokers.

During premarketing period, underwriters use nonbiding indications of interest collected to determine IPO offer price. In placing IPOs, underwriters face a strategic allocation decision and they exercise considerable discretion in allocation of shares to the two groups of potentially asymmetrically informed investors.

Regular investors are more easily identified during the pre-selling period and thus are invited to submit premarket indications of interest. Regular investors also know that their willingness to reveal information during the premarket period will affect the final offer price and their allocation of getting the issue. The result of such an allocation mechanism promotes regular investors to reveal their private information to underwriters.

For underwriters, by giving allocation priority to regular investors, they bear the cost of inducing such investors to reveal information truthfully. The inventors of this model, thus, conclude that a uniformed price restriction forces underwriters to underprice to all investors in order to place an issue when, in fact, only a segment of investors, regular investors, need to be compensated for sharing their private information.

### 3.3.4. Impact of Underwriters' Reputation - Carter and Manaster Model (1990)

This model is built upon the assumption that the greater the proportion of capital participated by informed investors in an IPO, the greater is the equilibrium underpricing. Carter and Manaster argue that prestigious underwriters are associated with lower risk offerings and with lower initial returns.

When making a public offering, low risk firms want to reveal their good characteristics to the market. One way for them to do is to select underwriters with high prestige. Having a prestigious investment banker underwriting a new issue shows the issuing firm's confidence in the prospects of his equity.

However, less risk associated with the prestigious investment banker may also produce another fact. Carter and Manaster model believes that marketing by underwriter's reputation can predict the level of information acquisition activity. When resources needed for information acquisition on new IPOs are scarce, investors will concentrate their resources in acquiring information for

the most uncertain securities. With lower risk associated with prestigious investment banks, there is less incentive for investors to acquire information and there are fewer informed investors. It is assumed that if informed investors move their capital to highly uncertain IPOs, chances for underpricing and subsequent price run-up for these firms are greater. Consequently, issues underwritten by prestigious investment bankers are associated with IPOs that have lower returns.

Carter and Manaster model is unique in the sense that combined with this model there is empirical analysis to support the theory that underwriter prestige is associated with the marketing of low risk IPOs. Based on tombstone advertisement brackets, the researchers developed an observable underwriter reputation variable of ranking scale. The analysis reveals a mean return of 13 percent for IPOs underwritten by the prestigious underwriter group, and 19.5 percent for the nonprestigious underwriter group. As predicted, the means are significantly different at a five percent level. Such empirical results lend strong support to the model and is not available to previous researchers.

### 3.3.5. Discussion

Different from the theories discussed in the previous section, the models in this section emphasize the informational asymmetries between issuer and underwriters and between investors and underwriters. Appropriate IPO pricing is decided by the market's valuation of shares being sold. However, information on the market's valuation on new securities is difficult to gather. The basic difficulty for underwriters to collect information useful to price an issue is that informed investors do not have incentives to reveal positive information before the stock is sold. By keeping such information to themselves, the informed can expect to benefit by paying a low initial price for the stock and then selling it at a higher price in the aftermarket. The models

discussed in this section are created to overcome this type of asymmetry by what some scholars call the certification role for underwriters.

The model by Baron (1982) asserts that large average underpricing for IPOs is the result of issuers' uncertainty about the equilibrium price of their securities being sold. According to this model, underwriters possess better information about investors' demands for new securities. Therefore, the underwriters are better informed about the appropriate price for IPO shares than issuers. On the other hand, issuers' uncertainty makes them to depend on investment banker's pricing advice. From underwriters' point view, they have incentives to recommend an offering price that is lower than the market value because underpriced securities can reduce their efforts to sell the issues. Underpricing tends to be more consistent than overpricing (Price Waterhouse, 1993). Modest underpricing has certain merits, such as aftermarket support and enhancing the possibility of a successful secondary offering.

Such an assumption, however, does not have strong empirical evidence in empirical studies that are subsequently conducted to test this model. For example, Muscarella and Vetsupens (1989) examined the IPOs of 38 investment banks that are marketed by the investment bankers themselves. If Baron's model is correct, there should be no information asymmetry between issuers and underwriters because they are the same in this case. If there is no informational asymmetry, these IPOs should be less underpriced than those IPOs whose issuers and the underwriters are not the same. Contrary to Baron's theory, Muscarella and Vetsupens (1989) find that self underwritten IPOs by securities firms display underpricing comparable to that of other IPOs.

In their model, Benveniste and Spindt (1990) suggest that underwriters could mitigate the informational asymmetry between underwriters and investors by using discretion over allocation and pricing to induce investors to reveal positive information. Their model describes premarketing as an auction conducted by the underwriter in which investors submit bids. Investors

understand how their indications of interest will affect the final offering price and allocations they receive. They know that IPO offer prices are set low to provide profit and compensate those who disclose truthfully their private information. For investors, the amount of compensation required depends on how much investors expect to profit by hiding the information. For underwriters, by choosing the discretion rule, they can induce investors to reveal their information and mitigate information asymmetry.

Similar to the model by Benveniste and Spindt (1989), Benveniste and Wihelm Model (1990) assumes that underwriters can induce investors to reveal their private information in exchange for priority in allocation. Moreover, the model argues that underwriters can reduce underpricing and marketing efforts by selling new shares repeatedly to the same regular investors. The model designates a two-stage allocation mechanism in which the offer price and allocation are determined by indications of interest solicited by underwriters during premarketing period.

The models by Benveniste and Spindt (1990) and Benveniste and Wihelm (1990) are theoretically sound. However, the basic proposition raised in the models lack sufficient empirical support. First of all, uniform-price restrictions imposed by regulations increase the cost of soliciting information from regular investors. When combined with evenhanded distribution restrictions, restrains make information gathering not feasible.

The models argue that IPO offer prices must be set low in order to compensate investors for revealing positive information on strong market interests. However, as shown in the studies cited earlier (Koh and Walter, 1989; Ritter, 1987) that it is not uncommon for underwriters to receive indications of interest for five times the number of shares available. IPOs are often over subscribed and motivations to underprice to attract investors are not necessary.

Secondly, the models formulated propose that the amount of compensation required depends on how much investors may expect to profit by hiding such information. Such a position also needs further empirical evidence.

Finally, the models contend that underwriters who have the discretion role of allocating IPO among both regular and retail investors would maximize proceeds by using a combination of price and allocation discrimination.

When low interest in new shares is revealed during the premarketing period, the issue will not be underpriced

### 3.4. Conclusion

In this chapter, three groups of models are reviewed. In each group of the models, one major participant of the IPO process is designated as the main decision maker and his information variables as key factors to realize the IPO price optimization. To be more specific, investors, issuers and underwriters each possess distinct piece of information upon which IPOs' values are judged and upon which each of the three works toward maximization of his own expectation.

The three distinct principals, namely issuer, investor and underwriter, are defined and their respective functions in the IPO process are recognized in the previous model. Such an approach lays the foundation of the model developed later in this study. The model to be presented in Chapter Six adopts such definitions and functions described, and it employs the utility maximization applied in the previous models.

In the theoretical models discussed in this chapter, either investors or issuers were addressed; some emphasize the side of investors (equilibrium model such as Rock model); others emphasize the side of issuer (signal model such as Leland and Pyle model); and still others focus on third parties namely underwriters or auditors (Baron; Titman and Trueman). Although the models are dominated by each of the principals and are not completely satisfactory, still

they lay the foundations for the model in this study. However, this study attempts to examine comprehensively both investors and issuer in an institutional framework.

Combining the merits of both signaling model and equilibrium models, the author's model integrates the concerns of both issuer and investors in the same process. For example, instead of commonly used fractional holding in the previous signaling models, the model in this thesis establishes signal variable of UFM, the distance from mid point of the price range to the final price.

Of the three groups of models, the models on underwriters seem to be most consistent and convincing, and are able to reflect underpricing mechanism in IPO floatation. The rest two groups of models in discussion have their respective limitations.

# Chapter Four

# Empirical Evidence of IPO Underpricing Shown by Literature and Possible Causes Perceived

Underpricing is generally characterized as abnormal high return on the first trading day (closing bid price) in relation to the issuing price. Since the publication of Ibbotson's pioneering study in 1975, empirical studies repeatedly show the evidence of IPO underpricing. Well documented in the empirical studies are three anomalies: (1) IPO underpricing is universal; (2) IPOs aftermarket performances vary in terms of size of excess returns; and (3) prevailing market condition makes impact on IPO underpricing. In addition to the confirmation of general phenomenon of IPO underpricing, empirical studies have also tested various hypotheses that speculate the causes of IPO underpricing. This chapter summarizes the findings of the empirical studies published during the past three decades.

## 4.1. Underpricing of IPOs: A Universal Phenomenon in Both Developed and Emerging Markets

The phenomenon of IPO underpricing in the United States and other developed markets has been extensively investigated, at least during the past three decades. Studies on such a phenomenon in the emerging markets are increasingly growing.

### 4.1.1. US Market

In one of the most frequently cited study which derived from his Ph.D thesis, Ibbotson (1975) suggests that new issues are underpriced in general. By investigating new issues registered with the SEC (N=771, sample period 1960-1969), Ibbotson discovers a positive average initial return of 11.4 percent for

**Table 4.1.1. Major Studies Of IPO Underpricing**

| Market | Author | Year | Sample Size | Sample Period | Major Findings: Average Underpricing |
|---|---|---|---|---|---|
| **US** | Ibbotson | 1975 | 771 | 1960-1969 | 11.4% |
| | Ibbotson et al. | 1988 | 8668 | 1960-1987 | 16.37% |
| | Ritter | 1984 | 5162 | 1960-1982 | 18.8% |
| | Ritter | 1987 | 1028 | 1977-1982 | 26.5% |
| | Chalk & Peavy | 1987 | 649 | 1975-1982 | 21.65% |
| | Miller & Reilly | 1987 | 510 | 1982-1983 | 9.87% |
| | Stoll & Curley | 1974 | 205 | 1957-1963 | 60.6% |
| | Logue | 1973 | 250 | 1965-1969 | 41.7% |
| | McDonald & Fisher | 1972 | 142 | 1969 | 28.5% |
| | Neuberger & LaChapelle | 1983 | 118 | 1975-1980 | 27.7% |
| | Neuberger & Hommond | 1974 | 816 | 1965-1969 | 17% |
| | Bear & Curley | 1975 | 140 | 1969 | 12.9% |
| | Reilly | 1977 | 486 | 1972-1975 | 10.9% |
| | Reilly & Hatfield | 1969 | 53 | 1963-1965 | 9.6% |
| | Block & Stanley | 1980 | 102 | 1974-1978 | 6.0% |
| **UK** | Buckland & Yeomans | 1981 | 297 | 1965-1975 | 9.6% |
| | Merritt et al. | 1967 | 149 | 1959-1963 | 13.7% |
| | Davis & Yeomans | 1976 | 174 | 1965-1971 | 8.5% |
| | McStay | 1987 | 238 | 1971-1980 | 7.4% |
| | Levis | 1990 | 123 | 1985-1988 | 8.6% |
| **AUSTRALIA** | Noti & Hadjia | 1983 | 47 | 1972-1980 | 20.8% |
| | Finn & Higham | 1988 | 93 | 1966-1978 | 29.2% |
| **JAPAN** | Dawson & Hiraki | 1985 | 106 | 1979-1984 | 51.9% |
| **SINGAPORE** | Sunders & Lim | 1990 | 17 | 1987-1988 | 45.4% |
| **HONGKONG** | Dawson | 1987 | 21 | 1978-1983 | 13.8% |
| **MALAYSIA** | Wong & Chiang | 1986 | 11 | 1975-1984 | 124.8% |
| | Dawson | 1987 | 21 | 1978-1983 | 166.6% |

the sample. He thus concludes that IPOs' positive initial performance are without departure from efficiency in the aftermarket. Following Ibbotson's study, many research studies have been conducted and further unveiled the phenomenon of IPO underpricing.

In studying a larger sample of IPOs (N=5162, sample period 1960-1982), Ritter (1984) provides additional evidence of underpricing of new issues. Of the sample studied, the average initial return is found to be 18.8 percent. An even higher initial return rate of 26.5 percent is reported in a consequent study by Ritter (1987) (N=1028, sample period 1977-1982).

In analyzing monthly average initial returns of a substantial number of IPO common shares in the major US stock exchanges (sample size N=8668, sample period 1960-1987), Ibbotson et al. (1988) find that the average initial return during the 27-year period is 16.37 percent. More specifically, the average initial returns are 21.25 percent during the 1960s; 8.95 percent during the 1970s; and 16.09 percent during the 1980s.

By examining daily returns across time from the issuing day through 190th day of the aftermarket trading (N=649, sample period 1975-1982), Chalk and Peavy (1987) report that abnormally high returns occur on the first trading day. Of the sample studied, the mean return on the first trading day is 21.65 percent.

From a sample of new issues (N=510, sample period 1982-1983), Miller and Reilly (1987) also find high abnormal returns on the first trading day. Of the sample studied, 356 stocks have positive initial returns of 15.39 percent. Daily net return for the total sample is 9.87 percent on the first trading day.

Similar findings are reported by many other studies. To cite just a few, the average initial returns are reported to be 60.6 percent (N=205, 1957-1963) by Stoll and Curley (1974); 41.7 percent (N=250, 1965-1969) by Logue (1973); 28.5 percent (N=142, 1969) by McDonald and Fisher (1972); 27.7 percent (N=118, 1975-1980) by Neuberger and LaChapelle (1983); 17 percent (N=816, 1965-1969) by Neuberger and Hommond (1974); 12.9 percent

(N=140, 1969) by Bear and Curley (1975); 10.9 percent (N=486, 1972-1975) by Reilly (1977); 9.6 percent (N=53,1963-1965) by Reilly and Hatfield (1969); and 6.0 percent (N=102, 1974-1978) by Block and Stanley (1980).

### 4.1.2. UK Market

Through analyzing a sample of issues in the London Stock Exchange covering a 10-year period (N=297, 1965-1975), Buckland and Yeomans (1981) report an average initial return of 9.6 percent of the sample investigated. In an earlier study of the UK market, Merritt et al. (1967) report an average initial return of 13.7 percent (N=149, 1959-1963). Lower but still positive average initial returns are found by consequent studies. Davis and Yeomans (1976) find average underpricing to be 8.5 percent (N=174, 1965-1971). In another study, McStay (1987) found underpricing in the UK market of the 1970s to be 7.4 percent (N=238, 1971-1980).

In a more recent study, Levis (1990) provides new evidence on IPO underpricing in the UK market. By examining a sample representing almost 85 percent of the entire offerings during the period studied (N=123, 1985-1988), Levis' study documents positive first day returns for IPOs on the London Stock Exchange. While out of the total 123 issues, 85 result in an average first day market-adjusted return of 15.9 percent, an average market-adjusted discount of 8.6 percent is found for the total sample studied. No significant differences are observed between opening and closing first day raw returns. Ninety-five out of 123 issues open at their offer price while 28 start trading below the offer price.

### 4.1.3. Australian Market

Abnormal high returns of IPOs are also reported by the studies on the Australian market. In a study by Noti and Hadjia (1983), Australian new equity issues are reported to be underpriced 20.8 percent (N=47, 1972-1980). In another study by Finn and Higham (1988), examination of new listings of

shares on the Sydney Stock Exchange (final sample N=93, 1966-1978) reveals a large positive average excess return from unseasoned issues on the first day of trading. More specifically, the average return on Day 1 is 29.2 percent in excess of the market index. Of the 93 shares examined, only 11 shares show negative market adjusted performance on the first day of trading.

### 4.1.4. Japanese Market

IPOs initial return is observed to be 51.9 percent in the Japan Stock Market by Dawson and Hiraki (1985) (N=106, 1979-1984).

### 4.1.5. Singapore Market

A study by Sunders and Lim (1990) that analyzes new listings made in the Singapore Stock Market (N=17, 1987-1988) reveals that underpricing on average is 45.4 percent for all issues. The degree of underpricing on the big board (Stock Exchange of Singapore) is found greater than over-the-counter market (SESDAQ) (56.2 percent vs. 35.7 percent).

### 4.1.6. Hong Kong Market

Average underpricing of 13.8 percent is exhibited by Dawson (1987) in the Hong Kong market (N=21, 1978-1983).

### 4.1.7. Malaysian Market

IPOs are underpriced even more in the emerging markets. A study by Wong and Chiang (1986) show the average underpricing in Malaysian market to be 124.8 percent (N=11, 1975-1984). In analyzing another sample (N=21, 1978-1983), Dawson (1987) observes that Malaysian new issues produce a very large mean return of 166.6 percent on the first day of trading. Such uptrend continues over the following year, but at a reduced rate of increase. It is

suggested that abnormal high initial return reflect immaturity of the new emerging market.

### 4.1.8. Chinese Market

In order to determine the relationship between initial market prices and aftermarket performance in China's infant security market, the author of this dissertation analyzes all the listing issues in China's national stock market, Shanghai Securities Exchange (N=70, 1990-1993). It is discovered that average initial return is as high as 579 percent for all new issues.

## 4.2. IPOs Aftermarket Performances: Immediately following Offering and Thereafter

Studies on IPOs aftermarket performances will be reviewed by two sub stages, short-term and long-term. For the purpose of the discussion, short-term is defined as the period that starts at the end of the first trading day and ends on the first anniversary of the security being sold, and short-term aftermarket performance is defined as the total return occurred during the period of time. Long-term is referred as the period that begins at the first trading day of the first anniversary of the issuance and continues to years after.

### 4.2.1. Mixed Findings on IPOs Short-Term Aftermarket Performance

Findings on IPOs' short-term performance are mixed. While some studies find that excess returns from IPOs are usually quickly adjusted on the first trading day, others demonstrate that underpricing can continue for three days to one week beyond the first trading day. Researchers who hold the former position are those who believe in the theory of aftermarket efficiency.

#### a. Excess Returns Unavailable beyond the First Trading Day

Several studies that assert the market efficiency hypothesis believe that IPO prices are normally adjusted during the first day of trading (Miller and Reilly,

1987; and Dawson, 1987).

A study by Miller and Reilly (1987) perceives that the market adjusts rapidly to any mispricing during the first day of public trading (N=510, 1982-1983). The average net return of the sample studied in the aftermarket (from the end of first trading day to four weeks after the offering) is not statistically significant at one percent level. Therefore, excess returns are not available to investors in the aftermarket.

Similar results are observed by Dawson (1987). By examining the markets of Hong Kong (N=21, 1978-1983) and Singapore (N=29, 1978-1983), Dawson shows that by the end of the first day of trading, excess returns are not available to purchasers in the secondary market. Total return for Day 2 through one month is -1 percent in the Hong Kong market and 0.6 percent in the Singapore market, indicating no significant excess returns for IPOs in the aftermarket.

Other researchers (Hess and Frost, 1982) reiterate such a suggestion that excess returns are quickly adjusted on the first trading day. In addition, they argue that even if high returns can be found beyond the first trading day they are not economically significant. Hess and Frost (1982) analyze all new issues of stock in utility industry listed on the NYSE (N=152, 1975-1977) to determine how new issues of seasoned utility securities perform in comparison with general common stocks. They report that from the end of the first trading day through Day 3, accumulative excess return is 0.65 percent, just barely greater than the minimum transaction cost of 0.53 percent. From Day 3 through Day 6, accumulative excess return decline to -0.73 percent. However, no evidence is found by the researchers that can reject the market efficiency hypothesis.

Still other researchers (Finn and Higham, 1988) find negative returns in the aftermarket. In a study of new listings of shares on the Sydney Stock Exchange (N=93, 1966-1988), Finn and Higham (1988) exhibit some negative

performance in the aftermarket from the fourth month of offering. In a more recent study, Aggarwal and Rivoli (1990) examine US IPO aftermarket performance one year after the issuance (N=1598, 1977-1987). Excluding the initial return, they find that stocks in their sample underperform the market on average by 13.7 percent.

**b. Excess Returns Continue in the Aftermarket**

In contrast to the research studies cited above that show no significant returns for IPOs in the aftermarket, the following studies (McDonald and Fisher, 1972; Chalk and Peavy, 1987; Reilly and Hatfield, 1969; and Reilly, 1973) find that abnormal returns continue in the aftermarket.

A study by McDonald and Fisher (1972) reveal that mean excess return to initial purchase is 28.5 percent in the first week after the offering and 34.6 percent one month after the offering (N=142, 1969-1970).

Chalk and Peavy (1987) also report significantly positive abnormal returns in the second day of aftermarket trading. While the mean market-adjusted return on the second day of the aftermarket trading is 0.97 percent, daily mean return becomes less disperse and are generally not significantly different from zero after the second day of aftermarket trading. Two percent accumulative return is found from the second day to the 19th day. A 17.99 percent cumulative return occur over the entire aftermarket period (second trading day to the 190th day of the aftermarket trading), indicating that significantly positive returns continue beyond the first trading day.

Reilly and Hatfield (1969) compare 53 new common stock issues sold during two sub-periods (December 1963 to August 1964, and January 1965 to June 1965) with 53 randomly selected OTC stocks. They find that on the first Friday after the offering, all new stocks have an average increase of 9.9 percent compared with 0.3 percent of the randomly selected stocks. The differences between the two groups of samples continue to be significant on the fourth Friday. The average price change of the new issues are 8.7 percent vs. 0.9

percent of the comparison group. The researchers, thus, argue that investors in new issues will experience superior returns in the short-run aftermarket because of a downward bias in the pricing of new stock issues.

Applying the same sample of new issues sold just prior to the 1966 market decline, Reilly (1973) claims that the average new issue price change from offering to the forth Friday is less than the average price change from offering to the first Friday. Reilly concludes that the average short-run price change for new issues is 9.6 percent higher than that of the Dow Jones Industrial Average and 9 percent higher than that of the National Quotation Bureau Over-the-Counter Industrial Average.

### 4.2.2. IPOs Long-Term Aftermarket Performances

Studies on IPOs' long term performance reflect both positive and negative findings.

#### a. A Mixture of Positive and Negative Returns

Using one offering per month for a 10-year period (N=771, 1960-1969), Ibbotson (1975) computes excess returns on IPOs whose offering price are at least $3.00 per share. He concludes that the results generally confirm that there are no departures from market efficiency in the aftermarket. However, he does find evidence that there is generally positive performance in the first year, negative performance in the next 3 years and generally positive performance on the fifth year.

#### b. Positive Returns Observed

Reilly and Hatfield (1969) compares new stocks long-run performance with the general stock market. Of 53 new common stock issues and the same number of randomly selected OTC stocks (N=53, 1963-1965), Reilly and Hatfield find that one year after the offering more than 50 percent of the new issues do better than the market indicators. New issues outperform OTC average by 20 percent and outperform DJIA by 36.9 percent.

### c. In Long Run IPOs Claimed to be Overpriced

Contradictory findings are reported by other researchers (McDonald and Fisher, 1972; and Ritter, 1991). McDonald and Fisher (1972) examine over 100 unseasoned new common stock issues brought to the market in the late 1960s (N=142, 1969-1970). They find that the mean return is -18.1 percent from the end of the first week to one year after the offering, and -19.8 percent from the first month to one year.

In a comparative study, Ritter (1991) compares three years total returns of IPO stocks from a new issue sample (N=1526, 1975-1984) with a control sample of the same number of stocks matched by period. After three years after going public, the average return for the sample IPOs is 34.47 percent vs. 61.86 percent produced by the control sample over this three year period. The median three year return is -16.67 percent for the IPO sample contrast with 38.54 percent for the control sample. Ritter thus concludes that IPOs appear to be overpriced in long-run.

Similar findings are also reported by Levis (1993). By using three benchmark indices to examine sample IPOs' three year aftermarkt performance (N=712, 1980-1988), Levis calculates performance measures for three-year cumulative average adjusted returns (excluding the initial return). Negative returns between -8.3 percent and -23 percent are discovered.

## 4.1.3. Impact of Prevailing Market Condition on IPOs' Aftermarket Performance - Cycles of Hot and Cold Issue Markets

The discussion in Chapter Two clearly implies that IPO offer price is directly affected by the prevailing market condition on the offering day. Nonetheless, the impact of market condition on changes from original filing price to final offering price has not been well researched. However, almost at the same time back in the 1970s when scholars began intensive investigations on IPO underpricing, the influence of the general market condition on IPOs'

aftermarket performance has always been on researchers' agenda. Findings present a mixed picture on whether IPOs' aftermarket performances are affected by a bull or bear market condition.

### 4.3.1. Returns and Volumes Cycling with Hot and Cold Markets

Hot market is defined as a market condition where incredibly and abnormally high IPO issue volume accompanied by high initial returns come to the market. While, cold market is referred as the period when IPO issue volumes are low and initial returns are poor or negative.

#### a. Abnormally Positive IPO Returns Found in Hot Market

Ritter (1984) investigates the behavior of IPOs that went to public in a 15-month period of hot issue market starting in January 1980 and extending through March 1981 (N=1075). It is found that during this period of time the average initial return on unseasoned new issues of common stock is 48.8 percent. In contrast, an average initial return of 16.3 percent is found during the cold issue market comprised the rest of the 1977-1982 period.

#### b. Initial Returns Leading Volumes

In their famous study that has been repeatedly cited, Ibbotson et al. (1988) examine the correlation between the average initial return and the number of new offerings. It is found that the period of high volume tends to be followed by periods of high average initial return. While using concurrent yearly data, the correlation is found to be 0.12, and it rises to 0.49 when the comparison is between the average initial return and the number of new offerings appearing the following year. Average initial returns lead volume by roughly 6 to 12 month because issuers react the receptive market with a six-month lag. The findings are interpreted as evidence that initial returns lead volume. The number of new offerings come in waves on heavy and light capacity which are highly serially correlated.

**c. Daily Volume and Underpricing**

Findings by Miller and Reilly (1987) also confirm the correlation between daily volume of trading and underpricing. This is particularly true for Day 1, when the significant price changes occur, strong trading volume is usually found.

**d. Cyclic Movement of Hot and Cold Market:**

**Hot Market Associated with Heavy Volume and High Return**

Ritter (1984) and Ibbotson et al. (1988) discover that following those hot periods, there tend to be periods of "heavy" volume accompanied by relatively higher initial returns (such as the periods of 1960-1961, 1967-1969, and 1980-1981). These heavy issue markets then give way to periods of cold spells with poor or even negative initial performance and "light" volume. Ritter concludes that hot issue markets tend to be associated with increasing volume (number of new issues) and underpricing is highly cyclical.

Cyclic movement of new issue premia and volume in hot and cold market is further confirmed by Ritter (1984) and Ibbotson et al. (1988). In Ritter's study, strong persistence of initial return and volume from month to month is observed. High degree of autocorrelation of the monthly average initial return is documented. The first order autocorrelation coefficient for the time series of monthly average initial return is 0.62. Volume cyclic movement on the monthly basis is even stronger. The first-order autocorrelation coefficient of monthly volume is 0.88.

The researchers conclude that hot and cold performances come in waves. The extent of underpricing and the hot-and-cold heavy-and-light cycles are clearly related. High volume months are almost always followed by high volume months with the exception of sharp market drops, such as the October 1987 crash.

### 4.3.2. Insignificant Impact of Market Status on Underpricing

From the experience of the UK market, Buckland and Yeomans (1981) assert that underpricing does not differ significantly in bull or bear markets for any given subscription. When excess demand is below 10 times of offering size, underpricing is 5 percent in bull market and 7.7 percent in bear market; and when excess demand reaches over 40 times, underpricing rises to 23 percent in bull market and 21 percent in bear market. The differences are not statistically significant.

Ritter (1984) reports additional striking results. For non natural resources issues within each risk class examined, there is very little difference in the average initial return between hot and cold issue market, and the difference verified is insignificant.

A study by McDonald and Fisher (1972) also reveals that subsequent mean return of hot issues market over the first year is equal to that of the entire new issue population. The researchers find that new issues in the hot market with initial excess returns over 50 percent have a subsequent mean return of -28.3 percent over the first year vs. -18.1 percent mean return of regular new issues.

Such assertion is also supported by Sanders and Lim (1990). In studying the markets of Singapore and Hong Kong, they found that the issues that come to the market when the market is falling are still underpriced and do not produce negative excess returns.

### 4.3.3. Implications of Market Cycles for the New Issue Premia

Ibbotson et al. (1988) asserts that the cycles of hot/cold market and underpricing make it possible to predict average initial return of the next month, with a high degree of accuracy, based upon the current month's average initial return.

Such a finding is significant because there is a time span between the time when issuers decide to go public and the offering is commenced, many firms

initiate the process when they see a receptive market to the offerings of other firms, especially those in their own industry.

**a. Advantages for IPO Issues in Cold Market**

Investment bankers often advise their clients that it is better to issue in a hot issue market. However, in their study which investigates the existence and implications of hot issue market, Ibbotson and Jaffe (1975) suggest something different. Based on the findings from serial correlation and runs tests, the researchers conclude that the first month series exhibits significant serial dependency and series of the first month's residuals does not follow a random walk.

Ibbotson and Jaffe (1975), thus, argue that it is quite possible that companies going public in a cold market are better off. The predictability of first month new issue premium may also be useful to issuers. In fact, issuers can use past data to select cold issue markets. In doing so, they will be able to obtain a higher offering price relative to the efficient price.

**b. Implications for Investors and Issuers**

While for investors, Ibbotson et al. (1988) point out that they may be able to concentrate their IPO purchases on those months which have the largest premium. Furthermore, they may wish to avoid offerings in calendar months following some cold issue markets when the first month average residuals are low or negative.

Based on the relation between volume and underpricing observed from empirical tests, Ritter (1984) argues that the best time for issuing firm to go public is during the high-volume period following a hot issue market. This is because the period of high volume tends to follow periods of high average initial return.

## 4.4. Empirical Tests on the Perceived Causes of IPO Underpricing

Academies have conducted substantial empirical studies testing the

hypothesis that theorists rationalize as causes of IPO underpricing. For comprehension, the existing studies are summarized under respective propositions in this section.

### 4.4.1. Demand and Underpricing

One of the most important elements that directly affects IPO pricing, namely demand for IPOs, is obviously under researched. So far, few studies on the UK market are identified but none on the US market.

**a. Underpricing-Demand Correlation Not Significantly Affected by Market Conditions**

High proportion of issues is found to be undersubscribed regardless of market conditions. However, undersubscription seems to be more particularly in bear market. In their underpricing-demand regression model, Buckland and Yeomans (1981) find that the constant term of regression falls in bear market from stable market while the coefficiency increases from 0.025 in stable market to 0.038 in bear market. Such findings reassure the relations between demand and underpricing in bear market. Nonetheless, the same researchers do not identify clear difference of demand-underpricing correlation between different market conditions. Differences between market status for any given subscription class are verified as insignificant.

**b. Underpricing Correlated with Oversubscription in Particular Market Status**

Buckland and Yeomans (1981) prove that price discounts are at all times associated closely with excess demand in the new issue market. The analysis is conducted in three market conditions, stable, bull and bear. In stable equity market conditions, small discounts of 3 percent are observed for issues which are less than four times oversubscribed. However, both mean and median discount levels increase very sharply thereafter. When issues are over 40 times

oversubscribed, a mean price revision of some 27.3 percent (median 25 percent) is experienced on the first trading day.

The same study reveals that in all status (stable, bull and bear), when demand (ratio of share applications received to shares issued) is smaller than 1, IPO is overpriced 8 percent (negative return). Underpricing turns to positive at 1.3 percent level when demand is larger than 1 but smaller than 4; 6.6 percent when demand is larger than 4 but smaller than 10; 14 percent when demand rose to 10 but smaller than 40; and 25.8 percent initial return when demand is larger than 40. On average of all demand level, underpricing is 9.7 percent.

### 4.4.2. Underwriter's Behavior and Underpricing

#### a. Rationing

Excess demand for new shares result in rationing thus affecting expected returns occurring to individual investors. Different markets are regulated by different sets of rules under which investors receive allocations of new issues. Both Ibbotson and Jaffe (1975) notice that in the US market it is not uncommon for underwriters to receive, prior to the effective date, indications of interest for five times the number of shares available. Consequently, underpriced shares can be severely rationed.

Using the example of the Helsinki Stock Exchange, Keloharju (1993) provides the evidence that confirms the hypothesis: average initial returns adjusted for the bias in allocation are lower than average unadjusted returns (N=80, 1984-1989). The institutional structure of the Finland stock market works at such a fashion that proportional allocation method is used. As a result, subscribers who place small orders are given greater proportional allocations than those who place large orders. As a consequence, the average return pattern is a function of the size of the order; very small orders produce significantly positive allocation-weighted average returns, whereas large orders generate significantly negative returns. For the 80 samples, while the average

initial return is 8.7 percent when not adjusted for the bias in allocation, it decreases to the range of -5.3 to -5.1 percent when the average allocation weighted returns is used.

**b. Impact of Over-Allotment on Underpricing**

As discussed in Chapter Two, often the underwriting agreement will grant the underwriters an over-allotment of Green Shoe option. Ritter (1987) asserts that profit margin on the commissions that an investment banker receives on incremental shares sold through the over-allotment option is very high. Investment bankers have an incentive to underprice an offer that includes an over-allotment option in order to increase the probability of exercising the option.

**c. Self-Marketed IPO**

The following two studies challenge the assumption underlying many of the previous research studies that positive average IPO returns primarily attribute to informational asymmetry between underwriter and issuer.

On studying IPOs whose issuers and underwriters are the same (N=17, 1970-1987), Muscarella and Vetsuypens (1989) find that lead manager underprice their offering deliberately. The average initial return is 13.23 percent in cases where the issuer acts as the lead manager in contrast to 2.17 percent in cases where the issuer is not the lead manager.

However, another study by Muscarella and Vetsuypens (1989) reveals no statistically significant difference between self-marketed IPOs and regular IPOs in terms of initial returns (N=38, 1970-1987). Of the sample examined, they discover statistically significant underpricing of about 7 percent occurring to self marketed offerings on the first day of trading which is not different from IPOs whose issuer and underwriter are not the same.

### 4.4.3. Underwriter Price Support and Underpricing

Empirical studies and practitioners all agree that underwriters' behavior in

pricing new issues is not uniformed. Through examining unseasoned new common stocks offered in the first quarter of 1969 (N=142), McDonald and Fisher (1972) report the evidence supporting such an assertion. Significant difference is identified (38.4 percent vs. 3.6 percent) in the initial price adjustment of offering by two underwriters with different ranks of prestige.

Underwriters legally can and do intervene to support IPO prices. Data collected by Hess and Frost (1982) show that stabilization occurs frequently. According to their finding, 57 percent of all underwritten NYSE-listed seasoned new issues of common stock between January 1, 1975 and March 1, 1977 are stabilized.

As discussed in Chapter Two, underwriter stabilization is accomplished when the underwriter of a new issue enters a syndicate bid by submitting the bid with the specialist for an exchange-listed stock, or enters a bid on NASDAQ for an over-the-counter stock. In the case of IPOs, the only limitation on the initial stabilizing bid is that it cannot exceed either the offer price or the bid of the highest independent dealer. Findings on the impact of underwriter price stabilization on initial return are not consistent.

**a. No or Negative Impact of Stabilization on Initial Returns**

Hess and Frost (1982) divide a sample of 152 seasoned utility equity issues into stabilized and nonstabilized offers. They find that stabilization have no price effect for fourteen days after the offer. By examining 540 IPOs, Hegde and Miller (1989) find the direct effect of stabilization to be negligible.

However, Stoll (1976) find that for a sample of 50 new equity issues, stabilized issues underperform nonstabilized issues by 4.2 percent over the first 10 days of trading.

Hanley, Kimar and Seguin (1993) examine 1523 firm commitment IPOs that took place over the 1982-1987 period. They find that after adjusting for volume, number of market makers, price, and volatility, spreads are narrowest for IPOs that are traded at prices from 3 percent below their offering price to

their offering price. For these IPOs, spreads widen when stock prices decrease over time. They conclude that the put option reduces costs to market makers.

**b. Stabilization Has Positive Impact on Initial and Aftermarket Returns**

In contrast to the above studies, Ruud (1992) finds that the distribution of IPO initial returns is consistent with the existence of stabilizing activities. In Ruud's study, one-day, one-week, and three-week aftermarket stock prices are collected for a sample (N=463, 1982-1983), and the distribution of initial returns of the sample is analyzed.

The distribution of one-day returns is found to peak steeply around zero and lack of symmetric curve in the negative tail. Ruud also observes that most IPOs without price support will have zero one-day returns and subsequently fall in price.

Ruud (1993) thus concludes that underwriter price support may account for the skewed distribution and the phenomenon of positive average initial IPO returns, even if offering prices are set at expected market value. Stabilization can readily account for the altering of the distribution of initial returns, stock prices are allowed to rise but are prevented from falling significantly until the issue is fully sold.

Ruud's study speculates a reasonable explanation to IPO underpricing. However, her conclusions seem to be not without bias. As disclosed in Ruud's research, only 10-20 percent of IPOs are stabilized. While according to underpricing literature, 70 percent of the IPO population are underpriced. Such a percentage is much higher than the cases stabilized thus leaving almost 50 percent of underpriced IPOs unexplainable by the underwriter price support theory.

Although actual stabilizing purchases are not observable, Hanley et al. (1993) provide indirect evidence of the existence of market stabilization through

the behavior of bid-ask spreads and prices by examining a large sample of NASDAQ traded IPOs with firm commitment method (N=1523, 1982-1987).

The researchers record the reported closing bid-ask spread for each security in the sample for each of the first 30 trading days. The relative bid-ask spreads are defined as a fraction in which numerator is closing bid-ask spread and denominator is the daily price of the security reported on Center of Research Stock Prices. It is found that the bid-ask spreads narrow when the market price is close to the offer price and stabilization is most likely. Furthermore, stabilized offers decline in value following the termination of stabilization, suggesting that stabilization and its termination affect market prices. The researchers, thus, conclude that stabilization significantly affects quoted spreads. Quoted spreads are narrower when stabilization is expected to be most important, i.e. when transaction prices are close to the offer price during the first 10 to 15 trading days. Stabilization has a tangible impact on prices, when stabilization is assumed to be suspended, market prices decline by approximately 2.5 percent over the following five days.

Hegde and Miller (1989) look at aftermarket bid-ask spreads and volume for a sample of 540 IPOs that took place in 1983 and 1984. Like Hanley et al. (1993) they find that spreads are narrower for recent IPOs than for other stocks. In addition, they show that volume is higher for IPOs than for other NASDAQ stocks.

By studying 510 IPOs that took place during 1982-1983, Miller and Reilly (1987) too show that after adjusting for offering price, aftermarket trading volume and the riskness of the stock, bid-ask spreads are narrower for IPOs that are not underpriced. However, they find a difference in spreads only on the first day of trading.

**c. Underwriter's Purchasing Behavior in the First Three Trading Days - over 20 Percent of IPOs Bought by Underwriters**

A study by Schultz and Zaman (1994) becomes the first to use intraday

data on underwriter quotes in the first three days of aftermarket to explain the reason that IPOs are underpriced (N=72, March 31-June 1, 1992). By examining IPOs in two groups: hot IPOs, IPOs that trade above their offering prices, and cold IPOs, IPOs that trade at or below their offering prices, it is found that underwriters are almost always at the inside bid for cold IPOs. Other dealers, by contrast, are about four times as likely to be at the inside ask than the inside bid for cold IPOs.

By splitting the sample into two kinds, underpriced IPOs, those with positive initial returns, and fully-priced IPOs, those with zero or negative initial returns, the researchers are able to examine time series behavior of IPOs and the aggregate buying and selling of underwriters. Their analysis reveal that a greater proportion of aftermarket volume is from sell orders of fully-priced IPOs than for underpriced IPOs. Underwriters appear to take the opposite side of most of these trades, and, on average, repurchase large quantity of stock.

Schultz and Zaman (1994), thus, conclude that volume from sell orders exceeds volume from purchase orders for both hot and cold IPOs, but the imbalance is greater for cold IPOs for each of the first three days of trading. Underwriters on average repurchase over 20 percent of the shares issued in an IPO during the first three days of trading.

### 4.4.4. Reputation of Underwriters and Underpricing

By studying all firms that issued IPOs of common stock in a period of five years (N=1028, 1977-1982), Beatty and Ritter (1986) reveal the relationship between underpricing equilibrium and investment bankers. The researchers report that underpricing equilibrium is enforced by investment banking industry.

A number of studies contribute the influence of underwriters' reputation on IPO underpricing. Empirical analyses on this subject conclude that images of underwriters are negatively correlated with the level of underpricing. Michally

and Shaw (1992) report that IPOs (N=889, 1984-1988) associated with more prestigious underwriters exhibit significantly lower initial returns than the IPOs associated with the less prestigious underwriters (4.5 percent vs. 10.9 percent). It was also noticed that large IPOs and IPOs issued by reputable investment banks also performed significantly better in the long run over 2 years than those issued by the less prestigious (-1.5 percent vs. -26.8 percent).

Similar findings are also reported by Johnson and Miller (1988). By studying IPOs of common stock (N=962, 1981-1983) and a sample of 196 investment bankers, the researchers report that issues underwritten by prestigious investment bankers are less risky. Prestigious bankers underprice less than non prestigious bankers (3.2 percent vs. 11.2 percent). Even when changing measurements for investment banking prestige, the result remains the same. It is also discovered that the level of underpricing is negatively related to the level of investment bankers' prestige.

Logue (1973) investigates the differences between the average performance of issues underwritten by prestigious investment bankers and non-prestigious bankers. By studying 250 new issues sold during a period of four years (N=250, 1965-1969) he concludes that there are significant differences between the average performance of issues underwritten by prestigious underwriters and by non-prestigious underwriters (relative performance index of 0.21 vs. 0.50). The performance of issues offered by non-prestigious firms is positively related to the number of remaining new issues offered during the month. Logue (1973), thus, concludes that the choice of prestigious rather than a non-prestigious investment banker might raise the price which investors are willing to pay for the shares sold.

### 4.4.5. Underwriting Methods and Underpricing

As discussed in the previous chapter, there are basically two types of contract methods: firm commitment offer and best efforts offer. In firm

commitment offering, the underwriter guarantees that the agreed upon amount of capital will be raised. The underwriter buys all the issuing stock from issuer at an agreed upon price and is responsible for selling them all. No matter how changing offering price in later stage, the underwriter will deliver the entire proceeds that is previously specified to the issuer.

In best efforts contract, the issuer and underwriter negotiate an offering price. The underwriter uses all his best efforts to raise all of the intended capital at the negotiated price. The offer will be withdraw from the market if there is not enough demand at the price and there will be no further low price offer. This offer reduce the risk of underwriter and leave more risk for issuer.

**a. Characteristics of Issuers and Type of Method Chosen**

In a sample examined by Ritter (1987), on average, 64.6 percent firms chose to use firm commitment contract and 35.4 percent chose to use the best efforts contracts. A comprehensive analysis provided some tangible features of both methods.

***Direct Costs of Going Public***

Ritter (1987) reports the evidence that the direct costs of going public are of the same order of magnitude for both methods for given size. Average transaction cost is 21.22 percent of realized market value of the securities issued for firm commitment offers and 31.87 percent for best efforts offers.

***Gross Proceeds Raised***

Average firm commitment offer raises almost four times as much capital as the average best efforts offer ($8.88 million vs. $2.37 million) (Ritter, 1987).

In relation to different features of two types of offering methods, researchers reveal characteristics of issuers that affect their decision of methods.

(a) Issuer's Sales

Firm commitment offers are used by firms that are, on average, substantially larger in sales and book value. Small and more speculative firms tend to raise small amounts of money by using best efforts offers.

(b) Issuer's Size

Seventy two percent of the offers that raise less than $2 million use the best efforts contract, whereas only 2.8 percent of the offers that raise $10 million more use the best efforts contract. Smaller firms tend to use more of the best efforts method (Ritter, 1987).

Chalk and Peavy (1987) also reveal that most IPOs (88 percent of the population) use firm commitment underwriting and small firms are more likely to use best efforts offering (N=649, 1975-1982).

The analysis by Ritter (1987) suggests that the issuing firm bears substantial proceeds risk for both firm commitment and best efforts offers, although it is higher for best effort offers. The investment banker in a best effort offer bears little risk, essentially all of the proceeds risk is borne by the issuing firm.

It is implied that firms that are more volatile in aftermarket are more likely to use a best efforts offers contract when going public. There appears to be much greater proceeds risk for best efforts offer.

**b. Impact of Different Methods on Initial Returns**

Studies on the impact of different methods on initial returns imply that investors can expect higher returns from issues which use best efforts contract. Chalk and Peavy (1987) observe that the best efforts offering outperform the firm commitment offering both on the offering day (37 percent vs. 19.7 percent) and aftermarket. Ritter (1987) finds that average initial return is 14.8 percent for firm commitment offers and 47.78 percent for best efforts offers. Of the sample studied (N=1028, 1977-1982), 24.7 percent of firm commitment offers have negative initial returns. In contrast, only 16.5 percent of completed best efforts offers have negative initial returns.

### c. Impact of Issuer's Ex Ante Uncertainty and Offering Methods Chosen

Ritter (1987) shows that for firm commitment offers, the offer price and number of shares can be and frequently are substantially different from those shown in the preliminary prospectus, especially when the issuer has great uncertainty about how much money that he will be able to raise. For firm commitment offer, average absolute percentage change is 23.8 percent between the actual transacted gross proceeds and the expected gross proceeds specified in the preliminary prospectus. Ritter's results strongly support the proposition that firms with higher ex ante uncertainty are more likely to use a best efforts contract than a firm commitment contract.

## 4.4.6. Pre-Post SEC (1933 Act) Factor and Underpricing

Tinic (1988) compares average initial returns for IPOs issued after the Securities Act of 1933 with that for unseasoned new issues issued in the pre 1933 years.

The assumption is that if it is true the issuing firm may underprice its new share to reduce the legal liability arising from any false or inadequate information in the prospectus, it should be the case that (1) IPOs issued after the 1933 Act should show larger initial returns than IPOs brought to the market before the 1933 Act, (2) experienced investment bankers should discount their offerings less than less knowledgeable competitor, and (3) small and riskier firms going public should tent to discount their IPOs more than firms less likely to face legal liabilities.

By looking at a sample of pre-SEC issues (N=70) underwritten by 47 investment bankers and post SEC IPOs (N=134) underwritten by 67 different investment bankers, the researcher claims that while the initial excess returns on the pre-SEC sample IPOs (N=70) are significantly positive (5.2 percent), the

magnitude of the underpricing in comparison to the doubled excess returns of 11 percent generated by the IPOs issued after 1933 (N=134).

Secondly, for prestigious investment banker, initial return of pre and post SEC are not differentiated. For ranked investment banker, initial return pre SEC is 4.9 percent and 6.2 percent for post SEC. For non ranked investment banker, initial return is 5.4 percent pre SEC and almost triples to 14.3 percent post SEC.

Thirdly, for pre SEC, there are no clear relation between the magnitude of underpricing and the quality of investment banking firms (4.9 percent vs. 5.4 percent). After 1933, prestigious underwriters have priced IPOs more fully than the fringe underwriters (6.2 percent vs. 14.3 percent). Finally, prestigious investment bankers started to avoid underwriting highly speculative small firms after 1933 (Tinic, 1988).

### 4.4.7. Initial IPO Offer Price and Magnitude of Underpricing

The studies by Ibbotson et al. (1988) and Chalk and Peavy (1987) demonstrate a close relationship between IPOs' initial offer prices and initial returns. It is found that lower priced IPOs tend to produce higher initial returns.

Ibbotson et al. (1988) report a difference of 34.2 percent between the initial returns generated by lower priced IPOs and higher priced IPOs, 42.8 percent for lower priced IPOs vs. 8.6 percent for higher priced IPOs.

Similar finding is also reported by Chalk and Peavy (1987). In their study, most of the sample's abnormal returns over the aftermarket trading period are produced by the lowest priced IPOs. While abnormal returns occur to IPOs of all price on the first trading day, they are much greater for the IPOs originally priced at $1.00 or less than for any other group. Underpricing is 56.4 percent for IPOs priced below $1.00 vs. 8.3 percent for those priced over $10.00. In

other words, lower priced IPOs produce higher abnormal returns on the first trading day aftermarket.

### 4.4.8. Issuer's Risk Proxy and Underpricing

Any risk perceived by investors in a new issue may prevent them from purchasing the share. Risk perceived by investors and underpricing are reported to be closely correlated by a number of studies. On examining the risk composition of firms going public, Ritter (1984) finds a positive relationship between risk and average initial return, and he presents evidence that some types of unseasoned new issues are underpriced more than others. In particular, high-risk initial public offerings are underpriced more than low-risk offerings. If high-risk offerings make up an unusually large fraction of the initial public offerings in a time period, this period tends to have unusual high average initial returns. Among the various risk proxies identified in the study are (1) the length of time a firm is established, and (2) soundness of the firm's operating history. Moreover, accounting information such as book value of the firm's equity, its annual sales or some combination of these are usually used by investors to measure the company's risk level.

**a. Age of the Issuer**

The number of years that an issuing firm is established is often attributed as an important risk proxy. For firms that have little or no operating history, there is most likely a great deal of uncertainty regarding the appropriate price per share.

In their widely cited study of 8,668 IPOs that were brought to the market in the period of 1960 to 1987, Ibbotson et al. (1988) report that the more established an issuer and the less investors uncertainty about the firm's real value, the lower the amount of underpricing is found.

Such assertion is further supported by the results of Ritter's empirical test (N=1526, 1975-1984) (1991). In his study, Ritter (1991) reveals a strong

monotone relation between age and initial return. Average initial return decreases as the age of an issuing firm increases. In other words, to investors longer operating history means lower risk of the firm and lower initial return.

Breaking down by the length of establishment, Ritter's study (1991) finds that initial return is 29.4 percent for firms with only one-year operation history; 14.5 percent for firms with two to four year history; 13.2 percent for those with five to nine years' history; 9 percent for those with 10 to 19 years history; and 5.4 percent for those over 20 years history. Ritter (1991) also finds that younger companies going public in heavy volume year do even worse than average.

In general, risk issues normally require higher average initial return and it is particularly true for young firms since age is a valid proxy for risk. Research studies shows a strong pattern consistent with such a notion.

**b. Size of the Issuer**

Different from age which is a fixed measurement, the size of an issuing firm can be measured by alternative accounting information.

***Sales***

Ritter (1984) and Ibbotson et al. (1988) use sales to measure company size. In analyzing a sample of firms (N=1075, 1977-1982), Ritter (1984) disclose that initial return increases as the sales of a firm decreases. In stable market, initial return is 43 percent (71 percent in hot issue market) for companies with sales under $500,000; 18 percent (36 percent in hot issue market) for those with sales of $500,000 to $4 million; and 10 percent (15 percent in hot issue market) for those with sales above $4 million. Empirical tests by Ibbotson and his associates (1988) also perceive that larger firms are underpriced less.

***Gross Proceeds Expected to Raise***

Employing gross proceeds as a measurement of issuer's size, Ritter (1991) discloses that there is a tendency for smaller offers to have the highest average initial return.

In studying a large sample (N=1526, 1975-1984), Ritter concludes that initial return increases as the gross proceeds decreases. Initial return is 27.5 percent for issuers with gross proceeds of $1 million to $3 million; 18 percent for those with $3 million to $5 million; 11 percent for those with $5 million to $10 million; 7 percent for those with $10 million to 15 million; and 10 percent for those with $25 million to $350 million.

**c. Other Risk Proxy: Variability of Return in the Aftermarket**

Through studying daily standard deviation of return for companies promptly listed on NASDAQ (N=926, 1977-1982), Ritter (1984) presents the same monotonic relation between this risk proxy of price variability and initial return. For standard deviation under 0.024, initial return is 6 percent, while for standard deviation above 0.076 initial return rises as high as 60 percent.

In addition, firms with high adjusted initial returns reportedly tend to have the worst aftermarket performance (Ritter, 1991). This tendency is stronger for smaller issues than larger issues. Larger firms tend to be underpriced less (Ritter, 1984).

### 4.4.9. Investors' Uncertainty of Issuer's Firm Value and Underpricing

Risk proxy presented by accounting information or physical index of the issuer is regarded as an objective measurement in the previous section. Investors' uncertainty, on the other hand, is more subjective and is more related to human perception. Investors' uncertainty changes as IPO transaction develops to different stages, and is, thus, described as ex ante and ex post depending upon whether it is before or after transaction day.

For this reason, there is no observable index to measure investors' uncertainty, and researchers are forced to apply indirect and composed accounting information in public offering such as secondary offering and inverse gross proceeds to investigate the impact of investors' uncertainty on

IPO underpricing. Studies using composed accounting information as proxy of investors' uncertainty are more analytical than those discussed in the previous section.

**a. IPO with Second Offering**

Muscarella and Vetsuypens (1989) examine a sample of second IPOs of common stock issued by formally public corporations but were later privatized (so-called reversed LBO) (N=74, 1983-1987) and compare it with a control sample of first IPOs (N=1114, 1983-1987). The researchers demonstrate that investors feel less uncertain about the firms going public second time. During the same period of time, the average initial returns for the sample of second IPOs is significantly lower than that for the control sample of first IPOs. Second IPOs are less underpriced (2 percent) than typical IPOs (7 to 8 percent).

**b. Inverse of Gross Proceeds**

Using the inverse of gross proceeds as a proxy for ex ante uncertainty in analyzing a sample IPOs of common stocks (N=510, 1982-1983), Miller and Reilly (1987) demonstrate the correlation between ex ante uncertainty and the degree of underpricing measured by the first day return. A significant positive correlation of 0.12 is discovered between the two.

Similar finding is reported by Ritter (1984). The degree of expected underpricing appears to be positively related to the degree of uncertainty about a security's value.

**c. Investor's Uncertainty of Offering Value**

Beatty and Ritter (1986) confirm that the greater is the ex ante uncertainty which is defined as investors' uncertainty about an offering's value, the greater is the expected underpricing. Using two proxies for ex ante uncertainty: the number of uses of proceeds listed in a prospectus and inverse of the gross proceeds raised in an offering, the researchers' regression provided empirical evidence that initial return positively correlated with ex ante uncertainty

(N=545, 1977-1982). However, $R^2$ is as low as 0.07. It is, then, not feasible for investors to predict initial return on a risk base.

**d. Impact of Adverse Information on Final Offer Price**

Loderer, Cooney and Van Durnen (1991) find that announcements of primary stock offerings by regulated firms depress their stock prices. They find little evidence that this decline is caused by relevation of adverse information. They interpret the negative returns around announcements of offerings as evidence of a downward-sloping demand curve for stocks. By studying Dutch auction share repurchases, Bagwall (1992) provides further evidence that the supply curve of stock facing the purchasing firm is upward-sloping.

### 4.4.10. Segments of Industries of Offering Companies and Underpricing

Studies repeatedly confirm a correlation between segmentation of industries of offering companies and underpricing.

**a. Differences between Industrial and Public Utility Firms**

Musulis and Korwar (1986) compare price performance of issues in the industrial sectors with that of the utility sector. Of the sample studied (N=690 for industrial sectors and N=716 for utility sector, 1963-1980), the researchers observe that return is -3.25 percent for industrial firms, and -0.68 percent for public utility firms. This finding is consistent with the fact that market anticipation by public utility offerings is greater than industrial firms.

**b. Financial Institutions Has Lowest Underpricing**

Crosssectional study in the US market by Ritter (1991) reveals that initial return as well as long term aftermarket performance for different industries vary widely. Financial institutions have the lowest initial return and produce the largest long-run aftermarket return, accumulating a total return of 128 percent over 3-year holding period. Of course, the impact of low interest rate of the early 1980s on low initial return can not be ruled out in this situation.

Of the sample studied (N=1526, 1975-1984), initial return is found to be 14 percent for all firms regardless industries. Breaking down by industries, it is exhibited that initial returns are 3.7 percent for financial institutions; 6.3 percent for airline industry; 7.6 percent for retail industry; 10 percent for service industry; 13.7 percent for computer industry; 14 percent for health care industry; 14.6 percent for electronics; 17 percent for wholesalers; and 21 percent for scientific instruments.

**c. Oil and Gas Firms Underpriced the Most**

Ritter (1984) testes the hypothesis that the market cycles of underpricing could be attributed to changes in the composition of the firms going public. In his study, strong evidence of market segmentation is demonstrated.

In analyzing SEC registered initial offerings (N=1028, 1977-1982), Ritter (1984) presents the evidence that underpricing of 1980 is most contributed by the particular industry of oil and gas which had a boom in that year and most oil and gas firms were startups. Compared with the initial return of all non natural resource firms, oil and gas firms had the highest initial return of 56.2 percent. Such high return, on the one hand, tripled that for non natural resource firms, and on the other substantially underperformed the market in the long run.

Ritter concludes that the hot issue market of the year 1980 is a result of the sudden immersing of natural resources firms going public. The high average initial returns can be attributed almost entirely to the natural resource industry. For firms in other industries, a hot issue market is barely perceptible.

## 4.5. Conclusion

The empirical studies reviewed in this chapter are essential in the sense that they present a complete picture of the underpricing phenomenon in the IPO market and they identify possibly related factors that attribute to IPO

underpricing. However, like any empirical studies the studies reviewed are not flawless.

A major weakness of the studies discussed in this chapter is the sampling method used. In many cases, data analyzed cover only a few months in the span of two years or a few months out of a calendar year. While in the financial industry, IPO transactions are affected by seasons. As a matter of fact, most of the transactions are implemented in spring and autumn mainly because of holiday season in winter and long summer vocations that take executives away from work. One example of seasonal factor is the deals that are forced to be completed before the holiday season which starts officially at Thanksgiving. Pricing policies and first day trading volume are sometimes artificially affected because both issuer and underwriter are in a rush to finish the deals. Consequently, abnormal returns may occur to the IPOs being offered. Therefore, if the sample studied does not cross the whole calendar year, conclusions made may be biased.

Furthermore, many of the studies discussed in this chapter are based on the data covering a period of 12-18 months. As known to professionals in the financial industry, economic cycle such as fluctuations of interest rates and changes of economic growth rate takes much longer than 18 months to complete a cycle. When the data sample fails to represent a whole economic cycle, it is unlikely to obtain results that realistically explain the floatation story.

Overall, underpricing as a universal phenomenon is proven by the empirical studies on different countries. Degrees of underpricing vary in different markets. Generally, underpricing is less in developed market, around 10%, and higher in the emerging market, around 50-100%. Of the causes of IPO underpricing revealed by the studies, this author believes that the following are most convincing, (1) underwriter' behavior and underwriting methods, (2) issuer's risk proxy, (3) pre-post SEC factor and (4) initial price.

Most of the conclusions derived from the studies are consistent and convincing, and made contribution to the understanding of IPO underpricing. However, the existing studies analyzed individual cases from one of the three principals. Inadequacy of such kind motivates the author to search for a new approach.

# Chapter Five

# Theoretical Bases of the Current Model

## 5.1. New Development Underlying the Current Model

### 5.1.1. New Development In the IPO Market

The model developed in this dissertation is based on the experiences of the 1980s and 1990s when significant developments took place in the IPO market.

**a. More Developed Market: Increased Size of New Issue Market and Diminishing Variance of Initial Return**

Empirical data show that the size of the new issue market grew dramatically from $500 million in 1960 to $16 billion in 1987; it was stabilized above $15 billion then jumped to $55 billion in 1993 in terms of annual gross proceeds. The number of underpriced issues also kept upward.

The average initial return maintained at a percentage of two digits for the past decades. After the interest rate reached the peak in the 1980s when annual initial return reached record high of 49 percent, the magnitude of average underpricing has been stabilized and shown slightly increasing.

Based on the sample collected by the author, recent years' average initial return is calculated. It is observed that the average initial return was 8 percent in 1988, 9.5 percent in 1989, 13.7 percent in 1990, 13.1 percent in 1991, 9 percent in 1992 and 13.3 percent in 1993. Such numbers show clear evidence of a more steady IPO market. Moreover, the variance of average initial return has substantially reduced, indicating less risk of the IPO market. All these facts suggest that the new issue market is more developed and more positively perceived.

**b. Quality of New Issues Improved**

According to Tinic (1988), prestigious investment bankers started to avoid underwriting highly speculative small firms after 1933. Since the SEC

executed more restricted monitoring policy and disclosure rules, the average quality of new issues has been constantly improved. Most of the firms that went public recently are ranked as AAA or AA. Low quality issue has experienced a learning curve and has less occurrence in the market. Imitated good issues referred in previous studies (Welch, 1989) gradually lost their market thus decreased.

**c. New Issue Market Becomes Regular Players' Club**

The new issue market is becoming an experienced investors' club. From the 1980s to the 1990s, total capitalization of the equity market increased 10 folds, and mutual funds have experienced exceptional growth and their capital strength reached all time high. Total assets of mutual funds have doubled and grew from $226 billion of October 1990 to $541 billion of mid 1993. Although the total assets still fall behind pension funds, mutual funds grew so rapidly that they have become a major force in the stock market especially new issue market. Now tradings made by mutual funds make up 30 to 35 percent of the daily trading volumes of NYSE compared with 10 percent in the early 1980s. These funds become major players in the new issue market. They follow new issues and possess clear information about new issues. These regular IPO players become a principal part of the group of experienced IPO investors. This basic fact laid foundation for building up the current model.

As Benveniste and Wihelm (1990) reveal that regular investors are institutional investors who repeatedly express interest in largest blocks of shares. While retail investors are smaller investors who receive allocations through retail brokers. Without experienced investors' participation, inexperienced investors alone cannot support IPO transactions.

**d. Underpricing More Related to First Day Trading**

Miller and Reilly (1987) report strong trading volume on the first trading day when significant price change occurs. According to the recent market record, on average over 50 percent of the issuing shares are changed hands on

the first trading day. This phenomenon makes the author to believe that underpricing is dominated by the market force.

**e. Underwriters Are More Likely to Sell IPOs to Regular Customers**

Entering the 1990s, underwriters experienced an integration. There is now clearly designated specialty for major investment houses in terms of geographic areas and financial products. After the integration, Wall Street adopted a hierarchy ranking system known as tombstone bracket for all investment banks. Underwriters in the top bracket have more power in the new issue market. They usually sell high quality new issues to their regular customers who are usually big mutual funds. As revealed in an earlier study by Spindt (1989) that underpricing equilibrium of new issue are enforced by underwriters, and distribution priority are given to underwriters' regular clients.

### 5.1.2. Characteristics of the Model

The model presented in this study examines the phenomenon of IPO underpricing from a comprehensive perspective. Different from previous research, this study attempts to investigate the phenomenon from a more applicable angle with the variables of the model being extracted from procedures of IPO transaction. Variables employed in the model are observable and are associated with market situation. In contrast to the previous models which are developed from the perspectives of economics, the current is built upon the theories of finance and real world business practices.

In an effort to overcome the weakness of previous studies where either investors or issuers alone were addressed; some emphasize the side of investors (equilibrium model such as Rock model); others emphasize the side of issuer (signal model such as Leland and Pyle model); and still others focus on third parties namely underwriters or auditors (Baron; Titman and Trueman), this study attempts to examine comprehensively both investors and issuer in an institutional framework. It tries to clarify underwriters' function of agents for

different principals at different stages (for issuer in Stage One and for investors in Stage Two). More specifically, this research focuses more on the different principals' (issuer and investors) optimization in different stages throughout the time line of IPO price determination which takes place in the last month of the IPO process.

## 5.2. Institutions: Decision Makers Defined in the Model

In the IPO process, there are two major interest conflicting decision makers: issuing firm and public investors.

### 5.2.1. Issuer

An issuing firm wishes to maximize its expected utility, meaning maximizing the cash proceeds raised through IPO plus the long term capital represented by remaining holding shares. Theoretically, issuer can sell as much as 100 percent of his new equity because the issuing firm wishes to raise as much capital as it can. However, the issuing firm faces many constraints. A major constraint is that the issuing firm must satisfy expected utility of investors as a whole. Only in this way, can the firm sell its shares.

An issuing firm's involvement with IPO market and financial institutions is of critical importance for its growth. The issuing process represents the single most important event in the life of the company.

It is worth mentioning a phenomenon revealed by recent emerging market that motivations for a company to go IPO are basically twofold: raising capital and promoting the firm's image. For a starting firm, the issuer is more likely to focus on venture capital raising and it normally chooses NASDAQ for listing. While for an established, well performed and financially solid corporation, the main goal for going public is to maximize its capital from sales of newly created or existing shares by close approximation of issue and subsequent market prices. To achieve this goal, the issuer wants to avoid any

undersubscription of the issue which adversely effects the company's credit worthiness in the future. However, sometimes a firm is concerned with the publicity associated with IPO and is willing to go public even at minor expense of sacrificing some capital. Such firms normally choose NYSE as a listing market.

On an institutional basis, firm commitment offerings are typically conducted by the more prestigious underwriters and the size of the offering is on average more than four times as large as best efforts offerings (Ritter, 1987). Both studies by Ritter (1987) and Mandelker and Raviv (1977) suggest that the best efforts method is used when there is greater uncertainty about the issuing firm. Other studies have found that the degree of underpricing declines as the prestige of the underwriter increase.

### 5.2.2. Investors

Investors collectively want to maximize their expected utility, in other words, to maximize the capital gains if they sell the shares right after IPO. They want to maximize their capital gains including both long-term and short-term gains depending on their investment preferences. Short term gain is equal to IPO underpricing discount. Long term gain is obtained from stock appreciation when reselling the holding shares in the aftermarket after a long holding period. During the IPO process, the format in which investors may maximize their utility depends on their expectation, whether focusing on short term or long term return.

Although issuing firms have superior knowledge and expertise about their own operations, investors' perception or expectations of appropriate discount levels are sometimes more accurate because of their experiences in the new issue market.

Similar to issuers, theoretically, investors wish to maximize their capital gains, and their utility also goes to positive infinite. To maximize capital gains,

they need lower IPO price. Investors' desire, thus, contradicts with expectations of issuers. There may indeed be an equilibrium level of underpricing a level which issuers, underwriters and investors thus appear to accept as necessary to the IPO process.

To price IPO accurately is very difficult. Because there is no observable market price prior to the offering and many issuing firms have little operating history. According to Ibbotson et al. (1988), if the price is set too low issuers do not get the full advantage of their ability to raise capital. If it is price too high, investors would get an inferior return and consequently might reject the offering. Without accurate pricing, the market could wither as one side or the other is unsatisfied.

So it can be concluded as such, the key optimization in the IPO process is optimization of offer price $P$ (same as final filing price $F$) for satisfying both issuers and investors mutually. An equilibrium of establishing an optimal price $P$ is concession and compromise between the maximization of issuer's expected utility and investors' expected utility.

### 5.2.3. Underwriters

Underwriters or syndicate of underwriters with their function of institutional intermediary act as moderators in the whole process of IPO. Their main job is twofold: investigating the firm and surveying the market, and searching internal and external information to set best price to satisfy both issuer and investors as a whole. They are hired by the issuer and their fees are paid by the issuer. In this sense, they serve as the issuer's agents. Since the underwriters' fees are associated to the capital raised, the underwriters strive to help an issuing firm to raise the IPO price to get maximum cash proceeds.

However, in order to make the new issues easier to sell and sell the largest amount as possible, the underwriters also need to set IPO price at an appropriate level so that more investors would be interested in buying it.

Setting an appropriate price in comparison to existing similar issues on the market usually means some discount.

In firm commitment offerings, the underwriters have incentives to set a relatively low price to ensure that the entire issue sells at the predetermined price. Because of their information advantages, the underwriters sometimes can convince the issuer that a relatively low price is appropriate if the issuer is unable to ascertain his own underlying value. Normally, the underwriter choose a slightly lower price than the estimate to guard against a weak aftermarket and give investors an incentive (Price Waterhous, 1993).

When a new issue is set at lower price, it is possible for the issuer to achieve an upward price momentum in the first day trading. Ibbotson at al. (1988) proves that lower priced IPOs have higher initial returns than higher priced issues (42.8 percent vs 8.6 percent). Ultimate large number of subscriptions will consequently promote investment bankers' image. In setting a lower IPO price, the underwriters consciously or unconsciously serve the interests of investors.

On the other hand, if the price is set too high in the situation of the firm commitment, the underwriters have a financial loss because they have to lower the price (break the syndicate) to sell the entire issue. In the best efforts case, if the price is too high, the issue is withdrawn, and the issuer raises no capital and the investment bankers receive no commissions. On the other hand, if the price is set too low, the issuer suffers excessive dilution of ownership. Also if the price is too low, it can negatively influence investors sense of the issuer's quality and underwriter's desire to participate in the offering (Price Waterhous, 1993).

Subjectively, underwriters' two conflicting approaches mentioned above solely serve the benefits of their own. However, objectively, this dual function makes them to advice the issuer at the stage of setting initial IPO price and to support investors at the time when the final IPO price is set. Underwriters dual

agent function for different principals is realized in different stages of the IPO process. In addition, underwriters have legal liability to investors. They represent investors in the process of due diligence.

### 5.2.4. Other Professionals

Other professionals involved in the IPO process, such as accountants and lawyers are less prominent decision makers and have less say in the IPO decision making process.

## 5.3. Investors Defined in the Current Model: Experienced and Inexperienced

### 5.3.1. Information Diffusion Theory

Rock model (1989) divides investors into two groups, the informed and uninformed. Statistically, it is difficult to verify this division, and the classification seems to be in conflict with some existing leading information theory.

According to Rogers' (1963) information diffusion theory, information is in a dynamic flow. No one posses it permanently. There are always someone who lead others in obtaining, accepting and retaining certain information. These people then become opinion leaders and are followed by others who accept the information later. When a certain piece of information is widely diffused, emerged are other groups of opinion leaders who have accepted other pieces of new information.

When applying Rogers theory to Rock model, we find that even within the informed there must be opinion leaders who have superior information about a new issue than the rest within the group. Such information may be disseminated to the rest of the informed, and to the uninformed making the uninformed the informed eventually. When new comers enter the market, they go through the same curve from the uninformed to the informed. In this sense,

it is not appropriate to designate one group as the informed and another the uninformed. Some empirical studies (Ritter 1984) have found that disclose information may reduce heterogeneity in exceptions between the informed and uninformed.

### 5.3.2. Experienced and Inexperienced Investors

During the IPO process, it is usually large subscribers that get first priority from underwriters to purchase IPOs. These investors are regarded as the IPO club's regular members and their probability of obtaining allocation is much higher than others especially when oversubscription situation occurs. For this reason, it is more appropriate to define these investors as a group called the experienced. Because of their special relations with underwriters and their accumulated capital powers, the experienced can constantly participate in the new issue market. While the rest have less chance to get allocations of IPOs, and have to buy in the secondary market thus pumping up the demand on the first trading day. In the new model developed here, this group is defined as the inexperienced.

Experienced investors have either superior information or capital, or both. The informed defined in Rock model are not necessary the experienced. Based on such a definition, the model is able to clarify real participants in both IPO primary market and secondary market.

### 5.3.3. Experienced Investors - Institutional Investors

In the investment community, there are two distinct groups that compose the participants of the IPO market. On the one hand, there are institutional investors including about 200 to 500 worldwide super large investment funds, most of which are mutual funds and pension funds; and a few thousands other institutional investors. These are professional investors. With the help of sophisticated analysts carefully studying line by line financial information

presented in IPO prospectus and industrial oriented background information from multiple sources, institutional investors are able to obtain maximum information from all possible sources about an issuing firm. The average capital of these funds range from $50 billion to $500 billion.

In the IPO process, institutional investors, especially those super funds, always act as leaders. Each single order of theirs is much bigger than that of total individual investors. Institutional investors are more influential and their subscriptions usually determine IPO issuing prices.

Because institutional investors have substantial capital power, they often make large subscriptions of IPOs and usually get relatively larger allocations of IPOs even when rationing is exercised. Also, owing to the nature of diversification of these funds, they have more opportunities to buy most IPOs from a variety of offerings.

Top ranking underwriters normally get orders from the same group of jumbo funds so that investment bankers often work out fee allocation based on funds' designations. Most of such powerful institutional investors fall into the category of the experienced as defined in 5.3.2.

Institutional investors are crucial to the success of an equity offering. This is because institutional investors generally purchase IPO for long-term appreciation potential not to flip over. Their financial strength enables them to possess buying power to ensure aftermarket buying support and liquidity therefore preventing aftermarket trading volatility. Their involvement also give credibility and prestige to new issue stocks. Most importantly, they possess resources to place larger orders, lending critical price tension to the offering (Salomon Brothers, 1996).

As for the investment behavior of the experienced, it does not conflict with random walking theory. Since most big funds have large capital and diversified portfolios, they can absorb more risks. As a result, relative risk associated with each IPO issue is reduced for big institutional investors, and these fund are less

sensitive to underpricing or overpricing. Whenever a quality new issue comes to the market, the experienced will buy it without much concern about whether it is underpriced or overpriced. Such investment behavior helps maintain their first front positions in the game and keep the closest relationships with underwriters. This does not mean that they are certain that their superior information will enable them to make huge profit on underpriced issues. Rather, it means that they can tolerate the uncertainty of two possible outcomes in terms of returns. Their net wealth can be sum of the gain from underpriced issues and losses from overpriced issues. Such investment approach can also attribute to the simple fact is that there are more quality underpriced issues in recent years' market, thus accumulated initial returns from IPOs are much higher than accumulated losses making the experienced wealthier.

### 5.3.4. Inexperienced Investors - Individual Investors

Individual investors depend either on their own instincts and resources or brokers' recommendations for IPO purchasing decision making. With less sophisticated financial skills, time and information, individual investors act as defacto followers. They normally follow experienced investors' opinions and actions.

Interviews with senior managers of Merrill Lynch, the leading worldwide retail broker, indicates that it is true that individual investors are most likely to act as followers of institutional investors, and they submit orders for the same new issue proportional with major institutional investors.

Since most individual investors have less capital power, they normally submit small orders (between 100 shares to 1,000 shares). In the best situation, individual investors' aggregate order is only about a quarter of the total IPO transaction. Consequently, they have very minor chance to play a role in offer price determination.

As a result, only a small percentage of wealthy individual investors with good rapport with retail brokers can get allocation of new IPO issues. The rest will have to be left out and can only buy new issues in the secondary market. The inexperienced have less influence in terms of determining IPO offer price. In this sense, it is appropriate to view 90 percent of individual investors as the inexperienced in the current model.

Institutional structure of IPO market decides that inexperienced investors' purchasing decision has minor impact on the process that IPO prices are set but more impact on the first day trading price. This is because most of them have to buy in the secondary market on that very first day.

It cannot be ensured that 100 percent of the experienced can get allocation of new IPO issues or 100 percent of the inexperienced will have to buy on the first trading day. However, it is safe to say that the experienced have higher probability of getting allocations of a new IPO and the inexperienced have higher probability of being kept out of the door and having to wait in queue till the new issue is traded in the secondary market.

### 5.3.5. Allocation Pattern for Experienced and Inexperienced Investors

The above discussion already presented an allocation pattern which describes purchasing behaviors of the experienced and inexperienced in both IPO primary and secondary market. Aggregately, in general, the experienced, namely institutional investors, get more than 75 percent of allocation of a IPO transaction in the primary market, and the part out of rationing will be purchased on the first trading day. Institutional investors are viewed by the underwriters as long-term investors. The underwriters' allocation strategy is to give priority to institutional investors whom it is believed to have long-term intentions of holding shares and will continue to buy in the aftermarket (Lehman Brothers, 1996).

Inexperienced investors have less chance to buy in the primary market due to a variety of reasons. Being large in number yet each having less capital to invest, inexperienced investors lack distribution channels that are as efficient as that for the experienced. There is less probability for underwriters to reach out to many inexperienced investors during the very short period of IPO offering. Due to limited sales force, wholesale is always easier than retail. Another fact is that, in general, inexperienced investors have no regular business relations with underwriters, and have less resources to establish such relations. Consequently, they normally get less than 25 percent allocations of IPOs in the primary market and most of them will have to purchase in the secondary market on the first trading day.

### 5.4. Information Structure Defined in the Current Model

When an IPO new issue is offered to the public, information important for investors to make decisions of buying or not is composed of two aspects: internal and external.

Internal information (internal thereafter) relate to the accounting information presenting true value of an issuing firm, while external information (external thereafter) relates to the market information reflecting the whole market condition.

At each stage of the IPO process, a different kind of information plays dominant role in influencing decision making. During due diligence and red herring preparation, internal information, namely company information, dominates the process and market information is limited. While market information, particularly that relates to the transaction, becomes more dominant when the final price is being determined in the later stage.

In other words, internal information plays more important role in setting up initial IPO filing price range, and external information is more critical in

respect of formulating final IPO offer price and affecting the first day trading price.

Both internal and external information will be linked directly to the model. In addition, a market demand index will be introduced to describe external information.

### 5.4.1. Internal Information

Rock does not deny that understanding of the issuing firm's value is best known to the firm itself. Rock recognizes that it is the issuing firm that knows best of its future plan. The firm's financial structure is signaled by how aggressively the firm prices its new issue. In terms of internal information defined in the new model, the issuers themselves and their agent underwriters should be classified as the informed but not as the uninformed found in Rock model. In his model, Rock fails to emphasize this, because he does not differentiate two kinds of information.

Internal information is mainly the best estimation of the true value of the issuing company, including the company's historical performance, future plan, financial and accounting information, and all company related information considered as inside information by Wall Street.

The percentage of total offering $\alpha$ is regarded as a major internal information variable which will be chosen in optimization process of Stage One.

In terms of price information, mid point of the initial filing price which in later analysis is regarded same as $M$, the mean initial filing price, is regarded as internal information; and public trading price $\tilde{V}$ (first day closing bid price) is referred as external information about the company's value. Underpricing $UTF$ defined in the study is the relative change of mean value of $\tilde{V}$ and offer price $P$ which refers to a mixture of internal and external information.

### 5.4.2. External Information

In Rock model, a fraction of external information is mentioned, such as competitors and discount rate of firm's cash flow. It is true that these items are important but they are not more critical than external information that is the whole market's response to the new issue and the market's previous reaction (demand) to issues with similar historical records and backgrounds. A major weakness of Rock model is that Rock fails to set variables to describe both internal and external information. As a result, his definitions of the informed and uninformed are difficult to follow.

In the model developed in this dissertation, external information is mainly about demand or subscription ratio in the IPO market. Balance between supply and demand sometimes is not determined by the true value of an issuing company, but rather by other overall financial market factors. There are many factors in the market that can affect demand for a particular IPO. For instance, at the time when interest rate is low, or when emerging market is very hot, demand for general new issues or new issues in the emerging market may be extremely high thus boosting prices on the first trading day and making it exceeding the true value of the firm. One good illustration of such a case is China's first overseas IPO in NYSE. When western investors were eager to participate in China wave, China's first international IPO attracted an oversubscription which was twelve times of the total offering .

### 5.4.3. Dissemination Offsets Information Asymmetry

Some of the earlier studies (Leland and Pyle) suggest that equilibrium with no communication could result in no projects being undertaken. The model in this dissertation takes a similar approach. In this model, information asymmetry or imbalance will lead to a dynamic flow, it can be transmitted and disseminated among the same group and between different groups (except for legal restriction such as China Wall) instead of static and non transferable as

considered in Rock model. The emphasis is particularly on the importance of communication in IPO process.

There are four channels for information transmission.

**a. Issuer and Underwriters**

The transmission of information between issuer and underwriters is first through due diligence exercise, and later through valuation meetings and pricing meeting. The issuer conveys as much as possible information of the firm's value to underwriters through these frequent communication. The underwriters make every effort investigating as detailed as possible all aspects of the company by repeated visits to the firm physically and talk with the management.

Some literature mentions the issuing firm's attempt of hiding its real story and imitating as a good firm (Welch, 1989). This author believes that imitation will not last long and will not escape the eyes of experienced underwriters and its legal councils, more importantly, from SEC disclosure rules. For this reason, the issuer is less likely to risk his deals by imitating a better company.

**b. Issuer and investors**

In the early stage of the IPO process, the issuer has no way to communicate with investors directly. The communication is usually through underwriters as an intermediate. In the later stage of IPO, specially designed road show provides opportunities for the issuer to communicate with investors directly even on the one-on-one base. Sometimes, information is indirect. For instance, investors' opinion on the final price determination cannot be communicated to the issuer directly but through the number of orders they submit.

**c. Underwriters and investors**

Communications between the underwriters and investors is an on-going process throughout the IPO process. Especially, the underwriters' worldwide

sales force keeps investors closely informed on updated development of the transaction and relevant information related to the issuing firm.

**d. Investors and investors via media**

There is almost no previous study on this topic. Theoretically, there should be no communication among them because of the nature of competition. However, public information such as country and industrial background information, is shared by every investor, both the experienced and inexperienced, to a maximum level. Nonetheless, media start to expose the transaction after the distribution of red herring, mass media act as intermediate for passing along information among investors. The scale and depth of media coverage will disseminate information among investors significantly. Most inexperienced investors are learning experienced investor's opinion through published newspapers during the period from red herring to the first trading day. Such dissemination of information produces psychological effect on investors and indirectly affect the IPO price.

### 5.4.4. Information and Decision Making

Information is not the equivalent of decision making, and it does not by itself directly set the tones in investment decision. Rather, information is first screened and processed by holder of the information who comprehensively filters and evaluates the information. The holder incorporates his/her own insights and considerations before a final investment decision is reached.

## 5.5. IPO Process: IPO Price Determination

The current model takes an inductive approach and it attempts to induce from IPO practice to a general theory so that the model can be applied to real IPO transactions. With such a motivation, the model strives to be an abstract of a real story of the flotation process.

As discussed in 2.2.2., the whole IPO process usually takes five months (auditing result is valid for 135 days only, thus setting time limits of the process), commencing with an issuing firm's preparation for auditing. Although underpricing is a key concern in the IPO process, it surfaces only in the stage of IPO price determination and does not become an issue until the last month of the IPO process.

As concluded in Chapter Two, the development of underpricing goes through three independent processes: determination of initial and final IPO offer price, market's response with excess demand, and after market trading.

Most of the effort in the IPO process is spent in due diligence which takes about three to four months. As shown by the timetable in 2.2.2., the last month of this period (Day 40 to Day 64 in interim two) is the stage when price determined and underpricing becomes an issue. The model presented in this dissertation focuses on this important stage which is depicted as a time sequence commencing at the distribution of red herring, i.e. submission of the first amendment of the registration statement and ending on the first day of trading (Day 40 to 64 in interim two). For the purpose of modeling, this sequence of time is divided into two sub stages: (a) preliminary or initial price determination and (b) final price determination (road show and thereafter).

### 5.5.1. Pre Pricing Stage

The main purpose of due diligence which makes up most of the pre pricing stage is to verify the true value of an issuing firm. Included in the due diligence are financial auditing of the issuing company by reputable auditors, investigating and evaluating of the issuing company by underwriters and their councils, and background study by underwriters about the whole market to ensure that the transaction is a good one. All these activities are associated with preparation of registration statement with the SEC. During this process, investors' interests are mainly accomplished with the help of professionals. In

pre pricing stage, information flow is mainly demonstrated via one channel mentioned above, issuer and underwriters.

### 5.5.2. Pricing Stage One: Preliminary Price Determination

As discussed in 2.2.2., the pricing process is primarily conducted in later part of Interim Two. According to the nature of pricing, it can be divided into two stages. Pricing Stage One commences when an issuing firm finishes its auditing and filing of the registration statement and continues to the time when underwriters help the issuing firm print and distribute red herring (preliminary prospectus) to prospective investors. In this stage, initial filing price range is decided and filed and in most cases printed in the red herring.

The initial filing price range, based upon which the underwriter solicits interest, is decided upon the new issue market's institutional structure, namely the firm's valuation results, the specifics and overall financial market (not only IPO market) condition, and policies of the investment bankers.

**a. Decision Maker: Issuer**

At this stage, decision maker is the issuer. The content of the decision is to determine the total issuing shares number $Z$ and percentage that will be offered to the public $\alpha$ and total shares will be offered to public $N=\alpha \cdot Z$. The issuer together with underwriters determine the initial filing price range $[P_H, P_L]$ (the mid point $M$ will represent $[P_H, P_L]$ and will be analyzed in Chapter Seven) based on issuer's optimization of expected utility.

**b. Consideration and Constraint of Choosing $\alpha$**

$(1-\alpha)$ has a signal function which has been revealed in many studies. Grinblatt (1989) and Downes (1982) conclude that high fractional ownership retained by the issuing firm signals high values of the firm.

***Control and NYSE Requirements***

$\alpha$ as ad hoc must be in the range from 25 percent (NYSE requirement) to 50 percent (control requirement). If the issuing firm offers only one class of

common shares and needs control vote, it must retain more than 50 percent of holdings in order to maintain control over the management. This sets one limitation for the issuer in terms of raising $\alpha$. There are also regulatory constrains for $\alpha$ . Most market such as NYSE requires minimum 25 percent of offering go to the public.

***Transaction Costs***

The final decision on the number of shares to be offered largely depend on the company's needs for proceeds and the company's market valuation. In choosing $\alpha$ , discounts or premia are not the only cost consideration. There are substantial transaction costs attached to IPOs' $\alpha$, which impose deadweight cost on the issuers. The higher is $\alpha$, the lower are the deadweight costs of issue. Consequently, the issuers wishes to raise $\alpha$ when it is possible.

***Dilution and Blue Sky Laws Concerns***

As a general practice, companies sell 15 percent to 40 percent of the post IPO outstanding shares (Price Waterhouse, 1993). Decisions on $\alpha$ chosen are influenced by a variety of factors, including selling enough shares to justify the expenses and to interest the underwriters. If the $\alpha$ chosen is too big, it could cause excessive dilution, perceived as a bailout or create problems with state Blue Sky laws.

***Long-term and Short-term Trade Off***

Balance of short term and long term is also a major consideration for optimizing $\alpha$. If $\alpha$ increases, the short term cash proceeds that the issuing firm can raise will increase. Therefore, the issuing firm has the tendency to raise $\alpha$ when it is possible. On the other hand, if the issuer believes in long term prosperity, limiting $\alpha$ can increase the issuing firm's long term wealth in terms of selling shares after a long holding period. Such limitations will leave the issuer more shares holding for future sale in the aftermarket with much higher price.

**c. Information Structure to be Built into the Model**

Information flow at this stage mainly concerns the issuer. Included in the information flow are (1) the issuer's capital raising plan, such as the target of minimum capital wished to be raised; (2) investors' absolute risk aversion $\gamma$, (3) regulatory requirements such as NYSE's requirement that minimum 25 percent of issuing shares must be offered to the public and total issue capital should be no less than $20 million; (4) financial and other accounting information consisted in the prospectus such as risk free rate $r$ and company's earnings $E$; (5) result of studies on competitors in the same industry; (6) findings on the stock performance and $P/E$ of the overall market or in similar industry, and applicable $P/E$ ratio to the issue; and (7) related stock price information such as industrial average price, country average price and competitors' prices.

**d. Information Dissemination Channel**

Dissemination of information is mainly via preliminary prospectus, also known as red herring, which has both legal and marketing functions. The secondary channel is media. After red herring being distributed, substantial media coverage takes place and will influence the market demand to be discussed in Pricing Stage Two.

**e. Valuation Procedure**

Preliminary initial filing price range determination is mainly based on the valuation results conducted by both underwriters and the issuer. Underwriters including lead manager and co-manager wish to use their professional knowledge and information obtained from the due diligence to reach the comprehension of the issuing company's true value. Underwriters' industrial related analysts play a key role and they normally build financial models for the purpose of valuation. With inputs of the company's current and projected earnings $E$, universal or industrial wide $P/E$ ratio, expected future growth, inherited risk of the business, prices of other similar offerings, and other adjustment factors, analysts will give a valuation range of the company. With a

couple of rounds of negotiations, final valuation range will be agreed upon by the issuer and accordingly an initial filing price range $[P_H, P_L]$ will be reached. The initial filing price range will be printed on the red herring and filed with the SEC on the first amendment and will be used in the whole soliciting period.

Underwriters' role at Pricing Stage One is to act as the issuer's agent. Underwriters help the issuing firm to maximize its cash proceeds and they are motivated to do their best because their fees are proportioned with size of the transaction. In order to enlarge the size of the proceeds, underwriters can raise valuation range and price range $[P_H, P_L]$. However, in doing so underwriters and issuer face two major constraints, (1) they have to follow acceptable market *P/E* ratio and (2) they have to match the opposite desire of investors' accepted level which normally means a lower price.

**f. Signal Function of the Range**

Another signal in addition to $\alpha$ that investors will take into consideration in their investment decision is estimated underpricing which can be read from the differences of initial price range $[P_H, P_L]$ and the valuation results. The price range can signal an estimated initial valuation discount which is usually incorporated into the price range. Normally, there are 5% to 10% spread between the mean initial filing price range and consensus of the mean of believed valuation results concluded by the accounting information on the red herring (see Section 2.6.4.).

Up to this point, information on demand such as total subscription is not available to issuers or the public because road show has not yet been conducted.

**g. Circling Demand**

According to SEC regulations, as discussed in Chapter Two, underwriters, after investigating the issuing firm, file the necessary information (e.g. type of business, nature of security, financial statements) in the preliminary prospectus. Then there is an approximately 20-day waiting period. During this cooling off period, also known as pre-marketing period, the underwriters survey the

market. Information is sent to prospective investors and in a firm commitment offering, investors are asked to indicate their willingness to purchase shares at initial price range $[P_H, P_L]$. This is so called to circle demand. The feedback of information on demand is helpful for underwriters to form the final offering price which usually falls in the range of $[P_H, P_L]$. The final offer price is usually set at the pricing meeting the afternoon before the day of formal initial public offering.

**h. Optimization**

In this stage, the first step is to infer what investors' demand for the IPO would be, by deriving their utility-maximizing demand function from their underlying portfolio optimization exercise. In other words, investors choose an optimal demand which will maximize their expected utility.

The second step is to analyze how the issuer will select an optimal issue price based on investors' demand function derived in step one. In fact, the issuer tries to select an IPO price to reach an equilibrium which makes demand (under such price) equal to the number of shares the issuer wants to offer. This price is the optimal price that will guarantee full sales of the IPO issue.

**i. Equilibrium**

As to be indicated in equation (6.8) of Chapter Six, an equilibrium will be reached. In such an equilibrium, issuer selects an optimal IPO price $P^*$ to make demand $\beta^*(P^*)$ equal to $N$ the number of shares issuer wants to offer.

**j. First Stage Underpricing *UFM***

In the next chapter, a model will derive a theoretical optimal initial price which is corresponding to empirically existing mean price $M$ of high-low initial price range in Pricing Stage One. In Pricing Stage Two, we will have a final offer price $F$. From the data, we know that there are differences between $M$ and $F$. We can then calculate this difference to get first stage underpricing which is our first definition of underpricing $UFM = (F\text{-}M)/M$. As

demonstrated in 6.1.4., *UFM* is a good proxy of market demand to signal the market perception of the IPO offered.

### 5.5.3. Pricing Stage Two: Road Show and Final Price Determination

In market practice, a one to two-week road show takes place right after the distribution of red herring. The issuing firm's senior management escorted by the investment bankers from the managing underwriter will visit several commercial center cities and give a series of presentations to major institutional investors. If the issuer interests media, by this time, media start to report the event extensively which serves as free advertising for the firm and the IPO transaction is disclosed to the public.

#### a. Decision Maker

Entering Pricing Stage Two, decision makers become primarily both issuer and investors. Investors indirectly involve in the final price determination through the orders submitted. The issuers and underwriters both wish a reasonable offer price to get maximum value as well as to attract maximum investors for a successful IPO transaction.

Underwriters function as moderators when market information is available. This process involves mainly sales effort, both lead manager and co-managers wish to sell more shares and sell them easily. Therefore, their goal is relatively biased toward investors' objectives, and they are more likely to bargain a final offer price $F$ on behalf of investors within the range $[P_H, P_L]$ of the issuer's acceptance. Even Rock who emphasizes the importance of information suggests that underwriters appeal to underprice issue to make them easier to sell (Rock, 1986).

#### b. Information Structure

Information in Pricing Stage Two is mainly dominated by external which consists of (1) market demand represented by total order share $\beta$; (2) risk free interest rate $r$ which represents financial market information; (3) backgrounds

of investors: their absolute risk aversion $\gamma$ and their previous IPO investment records and investment behaviors; (4) reaction to initial price range during the road show; (5) requirement to the issuer such as demand for green shoe; and (6) other similar new issues' prices and whose receptions from the market in the road show period.

**c. Information Dissemination Channel**

Information is disseminated mainly through road show including one-on-one meeting during the road show and frequent telephone conversations between investors and sales personnel from underwriters.

**d. Impact of Investors on Final Offer Price Determination**

Investors' impact on IPO final price determination is mainly realized through the indications of interest they expressed to underwriters. During the road show, orders constantly come in. After one to two weeks of the road show, the underwriters receive the full subscriptions $\beta$ from both institutional and individual investors worldwide through their European, Asian and US equity syndicate departments.

During the last few days of the road show, the underwriters already have an idea of the subscription size of the IPO. The total subscription $\beta$ is a clear indicator of market interest and will eventually affect the final IPO price setting. If $\beta$ is big enough, such as 10 times of the total offering $(\alpha \cdot P \cdot Z)$, the underwriters will take the high end $P_H$ of the initial filing price range as the final offer price $F$, or even go higher, but in a conservative way. This is the reason that the relative distance between $F$ and $P_H$ (or $M$), i.e. $UFM$, is used as a demand index.

**e. Maximizing Likelihood of Observations to Reach Conjectured Demand**

For fixing the final offer price, the advanced model acknowledges that the issuer may not have complete information about the true demand for the new issue and investors' risk preferences, i.e., the exact degree of risk aversion

among potential investors or their assessment of the IPO aftermarket performance. Therefore, the model approximates the process of information gathering stage (Pricing Stage Two) by a maximum likelihood method.

The issuing team files an initial price range $[P_H, P_L]$ with the SEC, and then takes its proposal on a road show. In their meetings with potential investors, especially institutional investors, the issuing team gets several observations on what the demand for the issue is likely to be in accordance with particular price within the tentative initial filing price range.

After maximizing of the likelihood of observed demand, the parameters of the true investor demand is determined, or a conjecture demand is reached. Using this conjectured demand, the issuing team then selects the final offer price in order to maximize the issuer's expected utility.

The initial filing price range can be described as a means of motivating the generation of information about these unknown parameters, and underwriting as a way of covering the residual risk of undersubscription that remains due to possible errors in parameter inference. The role of underwriting increases the accuracy of conjectured demand.

**f. Second Stage Underpricing *UTF***

In the second stage of pricing, final offer price $F$ is determined. Between $F$ and mean initial price $M$, there is the first period underpricing *UFM* which is used for demand index to signal the market perception. At the end of Pricing Stage Two, focus is on the first trading day closing price $T$. We can calculate the second stage underpricing *UTF* by the relative distance between $F$ and $T$. Being calculated from $T$ to $M$, we have aggregate underpricing *UTM*.

As to be indicated in Equation (6.11) in Chapter Six, a clear explanation to underpricing is demonstrated. Underpricing is positively related to interest rate $r$ and positively related to market demand. In other words, if interest rates rise, the issuer will be forced to discount IPO more in order to compete with risk free money market.

In the new model developed, underpricing is a means for the issuer to attract investors. By offering initial returns higher than risk free money market interest rate, the issuer makes a new issue worthwhile for investors to buy. In other words, underpricing of IPO is compensation to investors for their alternative investment.

Underpricing of IPO is also related to market demand. Underpricing is an approach applied by the issuer to stimulate the demand of IPO in both primary and secondary markets.

**g. Pricing Meeting**

Twelve hours before the first trading day, there is a pricing meeting at which the issuer reaches an agreement with the underwriters upon the final IPO offer price $F$. If $F$ is optimal price, occurrence of underpricing of IPO is a natural result.

Once the final offer price is set, an issue is allocated by quantity rationing which can be executed either proportionally by transacted ratio $b$ (ratio between total offer share $N$ and total demand $\beta$ ) or solely by the underwriters' discretion. We have to note, rationing is not necessary proportional to one's subscription, inexperienced investors are normally rationed to zero. It is the market's institutional feature that make us more concerned about $b$ rather than price $P$ in later process of the second stage.

**h. Green Shoe**

In Pricing Stage Two, as far as $\alpha$ is concerned, there is only one chance for it to be justified by overallotment known as green shoe option. According to NASD rule, maximum 15 percent of the original offering $\alpha$ can be exercised to satisfy excess demand.

## 5.6. Conclusion

Significant development in recent years took place in the IPO market which laid the basis of the current model. Firstly, the IPO market size has increased

and variance of IPO initial returns diminished. The quality of new issues are improved and imitated cases occur rarely. More importantly, mutual funds and pension funds are now act as dominant players in the new issue market and underwriters are more interested in selling IPOs to large institutional investors. Individual investors are more likely excluded from allocation and are forced to buy IPOs from the secondary market which makes first day trading active and further pump up the first trading day closing price. Based on such development, the author define institutional investors as experienced investors who are major players in the primary market and individual investors as inexperienced investors who are more likely to purchase in the secondary market.

IPO price determination can be regarded as two stages: in the first stage underpricing is reflected by the relative distance from $M$ (mean filing price) to $F$ (final offer price) and in the second stage underpricing is reflected by the relative distance from $F$ (final offer price) to $T$ (first trading closing price).

## Chapter Six

## The Theoretical Model

As discussed in Chapter Five, there are two primary decision makers in the IPO process: issuer and public investors. Both issuer and investors wish to reach optimization of their respectively expected utility. The model developed here will illustrate the sequence of decision making of both issuer and investors.

When setting the issue price for an IPO, one important consideration that the issuing firm must take into account is the amount of new shares investors are likely to demand at the various possible issue prices. Investors' likely demand schedule on the new IPO is generated from the utility-maximizing portfolio choice investors have to make when presented with a new IPO at a particular issue price.

The first phase of this analysis is to infer what investors' demand for the IPO is going to be, by deriving their utility-maximizing demand function from their underlying portfolio optimization exercise. The second phase is to analyze how the issuer will select an optimal issue price, given the market demand function of investors awaiting the issue.

The analysis presented below will derive investors' demand function for the IPO issue in Section 6.1, and the issuers' optimal pricing rule in Section 6.2. which make up the basic model. The advanced model which applies maximum likelihood method will induce conjectured demand in the information

gathering stage and will lead to the model for the underwriter's role in Section 6.3.

## 6.1. Foundation of the Basic Model: The Market Demand for the IPO

### 6.1.1. Investors' Terminal Wealth and Expected Utility

The representative investor can choose between two assets, (1) a risky IPO, costing $P$ per share, whose random aftermarket value (at the closing of the first trading day) is $\widetilde{V}$, and (2) a riskfree asset, offering a rate of return '$r$' between the offer date and first aftermarket trading day of the IPO.

If $W_o \equiv$ investors' initial wealth ( on the IPO offer date),

$\widetilde{W} \equiv$ investors' terminal wealth following aftermarket trading,

$\beta \equiv$ demand for IPO

and $\beta_o \equiv$ number of IPO shares purchased collectively by investors.

Strictly speaking $\beta_o = b \cdot \beta$ ($b$ is transacted ratio, see 5.5.3.g). Because $b$ is a multiple, for convenience of expression, let $b = 1$, thus $\beta_o = \beta$.

Investors' terminal wealth following aftermarket trading is defined as following:

$$\widetilde{W} = \beta \cdot \left[\widetilde{V} - P(1+r)\right] + (1+r) \cdot W_o \qquad (6.1)$$

The definition only takes into the consideration of the wealth created in the IPO process but not wealth produced by other portfolio investment or business activities during the period.

Investors choose $\beta$ in order to maximize their expected utility $E(U(\tilde{W}))$, given $P$, $r$, $W_o$, and the distribution function for $\tilde{V}$.

The following assumptions are made for this exercise:

***A.1: The aftermarket price $\tilde{V}$ is normally distributed, with mean $\overline{V}$ and variance $\sigma_v^2$.***

Assumption A.1 implies that terminal wealth $\tilde{W}$ is also normally distributed, with mean $\overline{W}$ and variance $\sigma_w^2$ given by:

$$\overline{W} = \beta \cdot \left[\overline{V} - P(1+r)\right] + (1+r) \cdot W_o \tag{6.2}$$

and $$\sigma_w^2 = \beta^2 \sigma_v^2 \tag{6.3}$$

***A.2: Investors' utility function is $U = \exp\left(-2\gamma\tilde{W}\right)$.***

$\gamma \equiv$ investors' absolute risk aversion coefficient.

This function provides a simple representation of risk-averse preference. Investors' absolute risk aversion is measured by $2\gamma > 0$.

Under assumptions A.1 and A.2, maximizing $E(U(\tilde{W}))$ is equivalent to maximizing

$$Q \equiv \overline{W} - \gamma\sigma_w^2 \tag{6.3a}$$

***Proof*:** Clarifying that maximizing $E(U(\tilde{W}))$ is equivalent to maximizing $Q \equiv \overline{W} - \gamma\sigma_w^2$.

Clearly, in general if $X \sim N(\mu, \sigma^2)$,

then $E(X) = \exp(\mu + (1/2)\sigma^2)$

Now, let $U = \exp(-2\gamma\tilde{W})$,

We have $E(-2\gamma\tilde{W}) = -2\gamma\overline{W}$

and $\mathrm{Var}(-2\gamma\tilde{W}) = 4\gamma^2\sigma_w^2$.

It follows that $E(U(\tilde{W})) = \exp\left(-2\gamma\overline{W} + \frac{1}{2}\cdot 4\gamma^2\sigma_w^2\right) = \exp\left(-2\gamma\left(\overline{W} - \gamma\sigma_w^2\right)\right)$.

Since exp $(X)$ is an increasing function of $X$, maximizing $E(U(\tilde{W}))$ is equivalent to maximizing $Q \equiv \overline{W} - \gamma\sigma_w^2$.

### 6.1.2. Investors' Utility Maximization and Investors' Demand Function

From (6.2), (6.3) and (6.3a), given the offer price $P$ and other parameters, investors' utility-maximizing and demand $\beta$ for the IPO is determined by:

$$max_{\beta} \quad \beta\cdot\left[\overline{V} - P(1+r)\right] + (1+r)\cdot W_o - \gamma\beta^2\sigma_v^2 \qquad (6.4)$$

Differentiating (6.4),

$$\frac{\partial Q}{\partial \beta} = \left[\overline{V} - P(1+r)\right] - 2\gamma\beta\sigma_v^2 = 0 \tag{6.5}$$

from which it immediately follows that:

$$\beta^* = \begin{cases} \dfrac{\overline{V} - (1+r)P}{2\gamma\sigma_v^2} & if\ \overline{V} > (1+r)P \\ 0 & if\ \overline{V} \le (1+r)P \end{cases} \tag{6.6}$$

Formula (6.6) indicates investors' demand function for the IPO. As we would expect, this demand is a decreasing function of the offer price $P$. The reason when $\overline{V} \le (1+r)P$ the demand $\beta$ becomes zero is that the expected rate of return on the IPO falls below the risk-free rate. This is no longer any compensation for bearing the risk presented by the IPO.

### 6.1.3. Relation between Underpricing and Demand

Formula (6.6) implies that there is a linear relationship between underpricing as measured by $\overline{V} / P$ and demand $\beta$ when $P$ is given. After rearranging (6.6) we have:

$$\frac{\overline{V}}{P} = (1+r) + \frac{2\gamma\sigma_v^2\beta}{P} \tag{6.7}$$

The above expression clearly indicates a linear relationship between demand and underpricing. From (6.7), one can see that the higher the demand, the bigger the underpricing or vice versa, when given $P$.

Equation (6.7) leads to the following proposition.

***Proposition**: The underpricing of the IPO is:*

*(a) an increasing function of market demand,*

*(b) an increasing function of the risk-free interest rate,*

*(c) an increasing function of the risk-aversion coefficient of the investors,*

*(d) an increasing function of aftermarket price variance, and*

*(e) a decreasing function of offer price.*

***Proof**: Differentiation of (6.7).*

Formula (6.7) is essentially identical to the formula (6.11) to be presented later in 6.2.2 except in (6.11) underpricing is a function of $\overline{V}$ while in formula (6.7) the underpricing is a function of $P$ (same as offer price used in the empirical study). Formula (6.7) is a more appealing form since it implies that given an offer price $P$, a high demand can drive up the aftermarket price of the IPO thus promoting underpricing as a whole.

### 6.1.4. Demonstrating *UFM* Is a Good Proxy of Demand $\beta$

Due to the difficulty of obtaining new issues' subscription numbers from

lead managers (such information is treated strictly confidential), it is necessary to develop a meaningful proxy to describe demand $\beta$. This author contends that *UFM* - underpricing at the first stage of IPO - is a good proxy of demand $\beta$. Such a proxy can be computed from public accessible data.

Mid point $M$ of initial filing price range or mean price is directly related to valuation results. In market practice, the mean price, can serve as a benchmark of initial price range to the investors (Linklaters & Paines, 1996). Investors' demand at $M$ is revealed in the resulting $M$ to $F$ movement. From our sample, range is between \$0 to \$3, and no more than \$3, in line with the professional view that spread of the range is generally 10-20% of the filing price (Lehman Brothers, 1996). Narrow spread shows less uncertainty range, therefore indicating mean price $M$ is a good summary of range.

The following illustrates the relationship between *UFM* and demand $\beta$.

*UFM* is defined as follows:

$$UFM = \frac{Final\ offfering\ price - mean\ of\ the\ initial\ price}{mean\ of\ the\ initial\ price} = \frac{F - M}{M}$$

here, *UFM* composed by initial filing price range and offering price is used as a device for extracting information on unobservable marketing demand.

In this section the following theoretical derivation serves as a rational proof.

***Proof:*** From Equation (6.6), we can calculate high and low ends of the initial price range $[P_H, P_L]$ as follows:

$$P_H = \frac{\overline{V}_H - 2\gamma\sigma_v^2\beta}{1+r},$$

$$P_L = \frac{\overline{V}_L - 2\gamma\sigma_v^2\beta}{1+r} \qquad (6.7A)$$

$P_H$: high end of initial filing price range.

$P_L$: low end of initial filing price range.

$V_H$: high end of value of the company.

$V_L$: low end of value of the company.

The mean of initial filing price range $M$ is equivalent to:

$$M = \frac{1}{2}(P_H + P_L) = \frac{(\overline{V}_H + \overline{V}_L) - 4r\sigma_v^2\beta}{1+r}$$

From the definition of *UFM*, we have:

$$UFM = \frac{F - M}{M} = \frac{F(1+r) - (\overline{V}_H + \overline{V}_L) + 4r\sigma_v^2\beta}{(\overline{V}_H + \overline{V}_L) - 4r\sigma_v^2\beta} \qquad (6.7B)$$

$F$: final offer price

Equation (6.7B) implies $UFM \propto \beta$

The above demonstrates that *UFM* is a good proxy of demand $\beta$.

### 6.1.5. Determining the Initial Price Range [$P_{max}$, $P_{min}$]

From conventional or traditional methods, the initial filing price range is determined by a proposed issue price calculated from an agreed upon valuation result plus or minus a cap. Actually high and low end corresponds to the maximum and minimum valuation of issuing firm's value.

Let $P_I$ = proposed initial price from valuation procedure.

$C$ = constant integer.

We can reach the conventional initial price range $[P_H^{'}, P_L^{'}]$ as follows:

$$P_H^{'} = P_I + C$$
$$P_L^{'} = P_I - C \qquad (6.7C)$$

$P_H^{'}$: price under the maximum valuation.

$P_L^{'}$: price under the minimum valuation.

Combining the merits of both conventional method and the author's method, we can either achieve the widest range (in the case of less confidence in pricing) or the narrowest range (in the case of more confidence in pricing). The following illustrates how the widest range is achieved.

We may combine the results of (6.7A) in 6.1.4 and (6.7C) to reach the widest range when needed. By changing "max" to "min" in the following formula the narrowest range also can be obtained.

$$P_{\max} = \max\left[P_H, P_H'\right] = \max\left[\frac{\overline{V}_H - 2\gamma\sigma_v^2\beta}{1+r}, \quad P_I + C\right] \tag{6.7D}$$

$$P_{\min} = \min\left[P_L, P_L'\right] = \min\left[\frac{\overline{V}_L - 2\gamma\sigma_v^2\beta}{1+r}, \quad P_I - C\right]$$

$P_{max}$: high end of the initial price range.

$P_{min}$: low end of the initial price range.

When estimating the initial price range $[P_{max}, P_{min}]$ numerically, we may apply expected valuation results $V_H$ and $V_L$ and estimated $\beta$ and $C$ from our past IPO experience. From such experience, $\beta$ can be chosen as an integer or half integer between 1.5 to 10, and $C$ can be chosen as an integer of half integer from 0 to 3 although integer ranges do vary depending on situations.

### 6.1.6 The Analytic Relationship between *UTF* and *UFM*

There exists an analytic relationship between *UFM*, the first stage underpricing, and *UTF*, second stage underpricing. Both definitions were given

in Chapter One.

From Equation (6.7),

Let $$\frac{\bar{V}}{P} = \frac{\mu}{M} = \frac{T - F + F}{M}\left(\frac{F}{F}\right) = (UTF + 1)\left(\frac{F}{M}\right)$$

All terms have been defined in the previous section.

We will have, $$(UTF + 1)\frac{F}{M} = (1 + r) + \frac{2\gamma\sigma_{V'}{}^2\beta}{M}$$

$$\frac{M}{F} = \frac{M - F + F}{F}\left(\frac{M}{M}\right) = -UFM\frac{M}{F} + 1$$

substitute into the above,

$$\Rightarrow \quad UTF = \left[(1 + r) + \frac{2\gamma\sigma_{V'}{}^2\beta}{F}\right]\left(1 - UFM\left(\frac{M}{F}\right)\right) - 1 \qquad (6.7E)$$

From (6.7E), we can see that under the circumstance where actual demand $\beta$ exceeds the expected or estimated $\beta_H$, under which high end of the price range $P_H$ is reached, $UTF$ - underpricing found at the second stage of IPOs - will instantly and drastically increase. This is because in normal IPO

procedure even if actual demand $\beta$ is larger than estimated $\beta_H$, lead manager will maintain final price $F$ within the original price range $[P_{max.}\ P_{min}]$. The reason being whenever $F$ goes beyond the originally set range $[P_{max.}\ P_{min}]$, another round phone calls to investors will have to be made to reconfirm purchases. There are only two hours between fixing the final offer price and confirmation of sales. Under time pressures and cost return trade-off consideration, if F is beyond but not far from the range, in most cases, investment bankers are unlikely willing to go through the hassle. However, if demand is extremely high and expected high return far exceed then the cost going through the hassle, the underwriters will be willing to fix the final offer price above the range and make another round phone calls. In our sample, 10% of the IPOs are actually priced above the range.

### 6.2. The Basic Model: Issuer's Pricing Decision

To this point, although we have not yet established the optimal offer price $P^*$, the root of the underpricing problem has already become clear. In order for the new issue to be sold at all, it must be true that $P(1+r) < \bar{V}$, and this automatically implies "underpricing" in the sense in which the term is defined.

But what is the equilibrium offer price? In order to answer this question, we have to turn to the optimizing decisions of the issuer.

### 6.2.1. Issuers' Optimal Issue Price

The issuer knows that the amount of IPO shares that will be subscribed by investors at any $P$ will be determined by investors' demand function for the IPO which was derived in (6.6). Therefore, in pricing the IPO, the issuer will have to make inferences about how many shares investors are likely to demand at each given issue price. In other words, the issuer will have to make guesses about $\beta^*(P^*)$ which is defined as a demand function under different offer price level.

Let us make a stronger assumption.

***A.3. The issuing firm knows the true demand function for its IPO, i.e. the issuing firm has precise knowledge of*** $\beta^*(P^*)$.

This assumption is stronger because it requires a combination of two fairly improbable things: (1) the firm knows how investors assess the new issue's aftermarket prospects, i.e. aftermarket mean price $\overline{V}$ and variance $\sigma_v^2$, and (2) the firm knows the risk preferences of investors, i.e. risk aversion $\gamma$.

Assume these conditions are indeed satisfied. How should the issuing firm price its IPO?

The answer is quite straightforward if the issuing firm has already decided on the total number of shares it wants to offer to the public in its IPO. Designate this number $N = \alpha \cdot Z$, where $Z$ is total issuing shares and $\alpha$ is proportion of total IPO issuing shares offered to the public. Since the issuing firm knows the demand function for its IPO to be $\beta^*(P^*)$, the firm must also

realize that in order to fully sell the issue, the IPO shares must be priced at a $P^*$ such that :

$$\beta^*(P^*) = N \tag{6.8}$$

Equation (6.8) serves as an equilibrium in our basic model. Under the condition of equilibrium offer price, $N$ in the right side represents total shares that the issuing firm is going to offer. On the left side, $\beta$ represents total shares to be transacted by all investors. Equation (6.8) implies that:

$$\frac{\overline{V} - (1+r)P^*}{2\gamma\sigma_v^2} = N \tag{6.9}$$

which, upon rearrangement, reveals that the optimal offer price equals to:

$$P^* = \frac{\overline{V} - 2\gamma\sigma_v^2 N}{1+r} \tag{6.10}$$

The issuing firm has no incentive to sell its issue at a lower price, and if the firm charges a higher price, it will fail to elicit a full subscription for the issue. Therefore, if the firm has already decided on offering $N$ shares, $P^*$ ($N$) in equation (6.10) is the optimal issue price which also represents an equilibrium offer price.

We can also derive the undersubscription case, if shares are overpriced at:

$$P > \frac{\overline{V} - 2\gamma\sigma_v^2 N}{1+r} \tag{6.10a}$$

### 6.2.2. Underpricing and Its Prediction: Proposition for Empirical Test

In equilibrium, is this IPO underpriced? If, the definition of "underpricing" means that the offer price $P^*$ is less than the expected aftermarket price $\overline{V}$, the IPO is clearly underpriced. If the degree of underpricing $U$ is measured by the ratio $\overline{V}/P^*$, we have:

$$U = \frac{\overline{V}(1+r)}{\overline{V} - 2\gamma\sigma_v^2 N} \tag{6.11}$$

Both Equations (6.7) and (6.11) reveal that:

***Proposition:*** *The underpricing of the IPO is:*

*(a) an increasing function of the demand $\beta$*

*(b) an increasing function of the risk-free rate r,*

*(c) an increasing function of the aftermarket price variance $\sigma_v^2$,*

*(d) an increasing function of investors' (absolute) risk aversion $\gamma$,*

*(e) an increasing function of the number of shares offered N,*

*(f) a decreasing function of the expected aftermarket price of the stock $\overline{V}$, and*

*(g) a decreasing function of the offer price P.*

***Proof***: *Differentiation of (6.7) and (6.11).*

The logic of these predictions are quite clear when one considers where the underpricing comes from. If investors are risk-neutral, the equilibrium issue price of the IPO has to be $\overline{V}(1+r)$. Therefore, the issue can be underpriced only to the extent of the risk-free rate. However, when investors are risk-averse, they will need a greater inducement to purchase the IPO, in terms of a lower offer price. This discount will be an increasing function of their own risk-aversion, and also of the IPO's aftermarket variance. By contrast, the higher the IPO's expected aftermarket price $\overline{V}$, the more willing investors should be to bear the associated risk, and therefore the less the percentage of underpricing should be.

## 6.3. Advanced Model in the Information Gathering Stage

### 6.3.1. Limitations of the Basic Model

The basic model presented in the previous section has certain limitations. The main virtue of the basic model is that it makes several intuitively appealing predictions about underpricing within a very simple framework. However, such simplicity comes at a cost.

First, there is no role for underwriting in the basic model, because it is assumed that the issuer knows the true demand function for its new issue and can clearly identifies the optimal offer price that will guarantee full subscription.

Second, there is no rationale for an initial filing price range or the red herring stage in the IPO process. These rituals are usually designed to generate information about the potential demand for the new issue, but in our basic model, this information is already assumed to be completely known.

The only way to create a role for underwriting and initial filing price range is to acknowledge that the issuer may not have complete information about the true demand function $\beta^*$ $(P^*)$ for its new issue. The issuer, for example, may not know the exact degree of risk aversion $\gamma$ among potential investors or their assessment of the IPO's aftermarket performance $\overline{V}$ and $\sigma_v^2$. Under the circumstance of withdrawing the simplistic assumption, the initial filing price range and subsequent road show can now be motivated as a way to generate information about these unknown parameters, and underwriting as a way of covering the residual risk of undersubscription that remains because of possible errors in parameter inference.

### 6.3.2. Stage of Road Show: A Conjectured Demand Being Reached by Maximum Likelihood Method

This section will model the information-gathering stage as a maximum likelihood problem. The issuing team files an initial price range with the SEC,

and then takes its proposal on a road show. In their meetings with potential investors, the issuing team gets several observations on what the demand for the issue is likely to be within the tentative initial price range filed with the SEC. Issuing team or underwriter may get particular order number in accordance with particular price within the initial range. By maximizing the likelihood of these quoted particular demands, we can reach the parameters of the conjectured investor-demand function. Using this conjectured demand function, the issuing team then selects the final offer price, usually within the initial price range, in order to maximize the issuer's expected utility (subject to a full subscription constraint).

From (6.6), we know that the demand $\beta$ and offer price $P$ have a linear relationship. Formula (6.6) can be expressed as:

$$\beta = \frac{\bar{V}}{2\gamma\sigma_v^2} - \frac{(1+r)}{2\gamma\sigma_v^2} P \tag{6.12}$$

To reflect the uncertainty in obtaining the demand function, from (6.12) we can assume:

$$\beta = b_1 + b_2 P + \varepsilon \tag{6.13}$$

$\varepsilon$ in (6.3) denotes random errors in the prediction of $\beta$, and $\varepsilon \sim N\left(0, \sigma_1^2\right)$. In the information gathering stage, suppose $P_1, P_2, \ldots, P_n$ are

some possible offering prices within the initial filing price range $(P_H, P_L)$ and $\beta_1, \beta_2, \ldots, \beta_n$ are the corresponding demands.

Since $\varepsilon$ follows a normal distribution, $\beta_i$ are identical independent random variables from a normal distribution. By maximizing the likelihood of the observed $\beta$'s, we can obtain the least-square estimates of $b_1$ and $b_2$. They are given below.

$$\hat{b}_1 = \bar{\beta} - \hat{b}_2 \bar{P}, \tag{6.14a}$$

$$\hat{b}_2 = \frac{\Sigma \beta_i (P_i - \bar{P})}{\Sigma (P_i - \bar{P})^2} \tag{6.14b}$$

where $\bar{\beta} = \Sigma \beta_i / n$, $\bar{P} = \Sigma P_i / n$

### 6.3.3. Modeling Underwriter's Role

Since $\hat{b}_1$ and $\hat{b}_2$ are only estimates of $b_1$ and $b_2$, $\beta$ can only be conjectured to a certain extent. In other words, the demand function generally cannot be conjectured perfectly, and there is always a residual possibility that the new issue will remain under-subscribed at the issue price. Underwriting can now be motivated explicitly as a way to eliminate this possibility, for a cost. Here in formula (6.13), underwriting can be used to reduce the variation

of $\varepsilon$ hence increasing the accuracy of the estimate of $\beta$. We may model the role of the underwriter through the variance of $\varepsilon$ which is $\sigma_1^2$.

$$\text{Let } \sigma_1^2 = c(1-g),\ (c > 0,\ 0 < g < 1) \tag{6.15}$$

where $c$ is some positive constants which may be modeled as a function of some aspects (such as performance) of the underwriter and $g$ may denotes the prestige of the underwriter and takes on values between 0 and 1. A strong performance and better reputation of the underwriter can then increase the accuracy in the prediction of demands $\beta$.

An exact overall confidence region with confidence probability of 1-$\alpha$ for $b_1$ and $b_2$ is given below:

$$\hat{b}_1 \pm t^{\alpha}_{2,n-2,\rho} S \sqrt{\frac{\Sigma P_i^2}{n\Sigma(P_i - \overline{P})^2}}$$

$$\hat{b}_2 \pm t^{\alpha}_{2,n-2,\rho} S \sqrt{\frac{1}{\Sigma(P_i - \overline{P})^2}}$$

where

$$S^2 = \frac{1}{n-2}\left\{\Sigma\left(\beta_i - \overline{\beta}\right)^2 - \hat{b}_2^{\,2}\,\Sigma\left(P_i - \overline{P}\right)^2\right\},$$

$$\rho = \frac{-n\overline{P}}{\sqrt{n\Sigma P_i^2}}$$

and $t^{\alpha}_{2,n-2,\rho}$ is the upper-$\alpha$ percentile of a 2-student $t$ distribution.

Given an offering price $P$, using the above confidence intervals for $b_1$ and $b_2$, one can then obtain a range of possible demands $\beta$. If the confidence intervals for $b_1$ and $b_2$ are small, so is the predicted demand range thus lead to a final offering price which will fulfill the objectives of the issuer.

# Chapter Seven

# Empirical Test and Results

## 7.1. Hypotheses and Methodology

In this chapter, empirical tests are conducted on a sample of data consisting of all the initial public offerings (IPOs) issued in the United States from January 1, 1988 through December 31, 1993. Criteria of data selection and source of data will be described in detail in Section 7.2. The ultimate goal of the analysis is to verify empirically the theories derived from this dissertation that underline IPO underpricing mechanism.

Let's denote (1) the mean of high-low initial filing price as M, (2) the offer price or final filing price as F, and (3) the first trading day closing price as T. Three definitions of underpricing are introduced based upon the three prices that appear at different stages of IPO process, namely:

$$UFM = (F - M * Adj1)/(M * Adj1)$$

$$UTF = (T - F * Adj2)/(F * Adj2)$$

$$UTM = (T - M * Adj3)/(M * Adj3)$$

where $UTF$ is the traditional definition of underpricing. UFM and UTF reflect two stage underpricing with UFM being the first stage underpricing and UTF as the second stage underpricing and UTM can be viewed as a cumulated effect. Adj1, Adj2 and Adj3 are adjustments that reflect the trend of the market movement. Therefore, UFM, UTF and UTM would be underpricing of the IPOs without the confounding effect of the market movement. Let dj1 be the DJIA (Dow Jones Industrial Average) on red herring, dj2 be the DJIA on the final offering day and dj3 be the DJIA on the first trading day. Adj1, Adj2 and Adj3 are defined as follow:

$$Adj1 = 1 + (dj2 - dj1)/dj1$$

$$Adj2 = 1 + (dj3 - dj2)/dj2$$

$$Adj3 = 1 + (dj3 - dj1)/dj1.$$

These three definitions will be used and compared with one another when the correlation's between underpricing and other variables are discussed throughout the rest of this chapter.

**Two-Stage Underpricing**

A major theory developed in Chapters Two, Five and Six recognizes the time sequence imposed by institutional framework for IPO procedures and its consequent impact on IPO pricing. It contends that IPO underpricing can not be described as an isolated event. Instead, according to the theoretical analysis in the previous chapter, IPO underpricing is shown in two stages and it deserves three, rather than one, definitions.

More specifically, two different IPO offering prices proposed by issuers - initial filing price and final offer price - reflect issuers' original and revised expectations on the market's reception of their offering stocks. While the first price determination is built upon issuers' internal information, the second price is the modification based upon additional external information.

Similarly, underpricing in the proceeding of IPO can be observed not only once, as traditionally rationalized, but three times. The first time is when red herring is printed for distribution. At this time, an initial filing price range (mean of the range is noted as M) is established. Underpricing, if there is any, is an intentional or negotiated discount based upon the valuation results of the issuing firm's value.

During the road show, the underwriters solicit potential investors' indications of interest on the IPO being offered. Soon after the registration of statement is declared effective, the final offer price (F) is set up. The establishment of the final offer price incorporates the information on market demand. Willingly or

not, issuers have to adjust their original expectations to the reality and may have to discount their IPOs if the market is not particularly enthusiastic about the new offerings. Underpricing here as a response to the market demand is described as UFM, where UFM=(F-M*Adj1)/M*Adj1, where Adj1 is the adjustment that takes into account the market movement between the days of red herring and the filing of the offer price.

Finally, IPOs are being traded in the market. At the end of the first trading day, there are usually discrepancies between the offer price and the closing price (T). Abnormally high return gained on the first trading day is the traditionally defined underpricing and is described as UTF in this analysis, where UTF=(T-F*Adj2)/F*Adj2, and Adj2 is the adjustment of market movement between the first trading day and the offering price filing day. In addition, I define UTM=(T-M*Adj3)/M*Adj3, the percentage change from mean filing price to the first trading day closing price and Adj3 is the appropriate market adjustment.

To sum up, for a particular IPO, there could be three different measurable underpricing observed. Each of the three is resulted from the circumstances of the financial market, but not from the behaviors of underwriters or issuers as described in the existing studies. IPO procedures are governed by regulations, and IPO underpricing is the consequence of the overall financial market condition, interest rate and demand in particular. Such an approach to studying IPO underpricing is original and has never been taken in the previous studies.

In the remainder of this section, hypotheses relating initial underpricing and various explanatory variables are proposed. Methods to test these hypotheses are subsequently also described.

### Interest Rate and Underpricing

As an extension of the main theory, a new proposition induced from the theoretical work is that IPO pricing is instantly affected by risk free interest rate and other alternate financial vehicles available in the market at the time IPOs are

being issued. Interest rate has immediate impact on IPOs' initial performances. As described in the basic model in Chapter Six (6.11), it is believed that IPO underpricing is, in general, positively related to risk free interest rate. IPOs coming to the market when interest rate is relatively higher are more likely to be underpriced. The studies conducted by Allen and Faulhaber (1989) suggested IPO discount is used by issuers as incentives to attract investors from alternative investment vehicles. From the above discussion, I formulate the following hypothesis that relate underpricing to risk free interest rate.

- $H_0$: IPO underpricing is unrelated to Risk free interest rate.
- $H_1$: IPO underpricing is positively related to risk free interest rate.

A one-sided two-sample t-test will be used to compare interest rates between times when overpriced and underpriced IPOs were issued. The above hypothesis will also be tested by a regression of UTF on the risk free interest rate when each IPO was issued.

### Demand and Underpricing

The impact of market demand on new IPOs is obviously under researched. In one of the few studies found (Buckland and Yeomans, 1981), the researchers discovered IPO discounts at all time are closely associated with excess demand in the new issue market. In this thesis, I argue that the distance from the final offer price to the mean of the high and low initial filing price, UFM, can be used as a proxy of the market demand. In Chapter 6, a positive relationship has been established theoretically (equation 6.7.). To test that the IPO discount is closely related to the market demand, the following hypothesis is formulated.

- $H_0$: IPO underpricing, UTF, is unrelated to the market demand index, UFM.
- $H_1$: IPO underpricing, UTF, is positively correlated to the market demand index, UFM.

The above hypothesis will be tested by a regression analysis of $Y$ on UFM, where $Y = 1/(1 - UTF)$. The transformation of UTF is carried out to stabilize the variance of residuals of the regression model and to improve the explanatory power of UFM.

**Proceeds and Underpricing**

The linear model presented in Chapter 6 suggests that the total proceed should be inversely proportional to IPOs' initial performances. As shown in Equation 6.11, offering size (total proceeds) is positively correlated with initial performance. Ritter (1991) has also concluded from his empirical study that initial return increases as gross proceeds decrease. Combined equation 6.11 and Ritter's (1991) work, the following hypothesis is formulated.

- $H_0$: Initial return, UTF, is unrelated to total proceeds, P.
- $H_1$: Initial return, UTF, is positively related to total proceeds, P.

The above hypothesis is tested by a regression analysis of initial return, UTF, on the reciprocal of the total proceeds, P.

**Hot/Cold Market and underpricing**

In this chapter, hot/cold market is defined by the number of IPOs issued in each quarter. A hot market condition occurs when the number of IPOs is high, say above twenty. A cold market condition occurs when the number of IPOs is low, say around ten. Findings by Ritter (1984) suggested that abnormally high returns occur in hot market condition. To test whether initial returns are related to market condition, the following hypothesis is formulated.

- $H_0$: Initial return, UTF, is the same regardless of the market condition.
- $H_1$: Initial return, UTF, is higher in the hot market than in the cold market.

This hypothesis is tested by comparing the initial returns in the hot and cold market using a two-sample t-test.

Another important hypothesis proposed in Chapter Six is that the status of market condition, hot or cold market, is affected by the concurrent risk free interest rate. Hot market is usually associated with a low interest rate environment, and cold market is usually associated with a high interest rate environment. The theory developed in the previous chapter offers approximate estimations that prevailing interest rate in the hot market is half of that in the cold market. Lower interest rate serves as an incentive for firms to go public. To study whether interest rates are different in two different market conditions, the following hypothesis is formulated.

- $H_0$: Interest rates are the same in the hot and cold market.
- $H_1$: Interest rates are different in the hot and cold market.

The above hypothesis is tested by comparing the interest rates of the hot and cold market using a two-sample t-test.

**Cross-sectional Analysis**

In an attempt to combine the previous univariate analyses together in deriving a better model to predict initial returns of IPOs, this analysis includes different type of industries that the IPOs are associated with as well as all the relevant explanatory variables. This section also provides some insight into the interrelationship among all the explanatory variables. The following three sets of hypotheses are formulated.

1. Hypothesis of UTF.
    - $H_0$: Initial return, UTF, is unrelated to any of the explanatory variables.
    - $H_1$: Initial return, UTF, is related to at least one of the explanatory variables.

2. Hypothesis of UFM.

   - $H_0$: UFM, is unrelated to any of the explanatory variables.
   - $H_1$: UFM, is related to at least one of the explanatory variables.

3. Hypothesis of UTM.

   - $H_0$: UFM, is unrelated to any of the explanatory variables.
   - $H_1$: UFM, is related to at least one of the explanatory variables.

The explanatory variables are demand index, interest rate, total proceeds, hot or cold market index, industry dummy variables. The second hypothesis tries to test whether the second stage underpricing UFM can be related to the explanatory variables. All the above hypotheses will be tested by regression of UTF, UFM and UTM on this whole set of independent variables.

### 7.2. Data

#### 7.2.1. Source of Data

The empirical study examines all the initial public offerings (IPOs) issued in the United States from January 1, 1988 through December 31, 1993 available from the Securities Data Company. The total number of IPOs provided by the Securities Data Company is 531.

The purpose for choosing this particular period of time for the study is that they are more recent, and interest rate during this six-year period experienced a drastic high-low cycle, falling from the highest of 8.83 percent in March, 1989 to the lowest of 2.84 percent in October, 1992. The sample covers all industries in the manufacturing sector plus commercial banks. After classification, 36 industries are consolidated into four sectors: (1) light industry, (2) heavy industry, (3) high-tech industry, and (4) banking industry.

For each IPO, the data acquired from the Securities Data Company include (1) issuer name, (2) offer date, (3) industry, (4) initial high filing price, (5) initial

low filing price, (6) offer price or final filing price, (7) total shares offered in the United States, (8) total shares offered globally, and (9) the first trading day closing price. (10) DJIA (Dow Jones Industrial Average) at red herring, (11) DJIA on the offering price filing day, (12) DJIA on the first trading day.

Risk free interest rate data is acquired from the Federal Reserve Bank. Rate applied in the analysis is three-month US Treasury Bills short term rate. Interest rate data are available on monthly basis.

One shortcoming of the previous studies is that in spite of larger samples of data from multi-years, they covered either selected data from each year or only several months but not all months of a year. The current study avoids such inadequacy by comprising all available data of six full calendar years. The size of the sample should provide sufficient statistical power to identify relationships between underpricing of IPO and other marketing factors.

### 7.2.2. Overview of the Data and Descriptive Statistics

In this section, I will give an overview of the data set used in the empirical analysis. Table 7.2.1 shows the distribution of underpricing by each of the three definitions. Column one is the distribution of UFM. Column two is distribution of UTF and column three is distribution of UTM. All the underpricings have been adjusted for the appropriate market movement.

The skewness of all three differently defined underpricing is greater than zero, and the kurtosis for all three underpricing are small positive numbers. This indicates that all three types of underpricing are relatively symmetric. From column two in Table 7.2.1, one can see that on the first trading day the best performed 1 percent IPO issues experience an initial return of almost 75 to 100 percent by definition of UTF while the worst performed 1 percent issues suffer a 13 percent to 26 percent loss.

Also, by the definition of UTF, column two shows that 90 percent (from 5

percent to 95 percent) of the IPO issues can expect anything between 6 percent initial loss and 50 percent positive initial return. Column three, definition of UTM, shows that 90 percent of the IPO issues produce initial returns between 34 percent loss and 60 percent gain when comparing the first trading day closing price with the mean initial filing price. Figures 7.2.1, 7.2.2 and 7.2.3 show the frequency distribution of the three defined underpricing (UFM, UTF and UTM).

According to the definition of UTF, 394 IPOs are underpriced, making up 74 percent of the sample, and 137 are overpriced, making up 26 percent of the sample. For the 394 underpriced IPOs, average underpricing is 15 percent. For the 137 overpriced issues, average overpricing is 3 percent. For the entire sample, average underpricing is 10 percent.

**Table 7.2.1. Distributions of UFM, UTF and UTM**
This table reports distributional statistics of initial underpricing defined as UFM, UTF and UTM respectively. UFM is calculated as (F-M*Adj1)/M*Adj1, where F is the final filing price or offer price M is the mean filing price and Adj1 is the adjustment of market movement between days of red herring and filing of offering price. UTF is calculated as (T-F*Adj2)/F*Adj2, where F is the same as above, T is the first trading day closing price and Adj2 is the adjustment of market movement between offer price filing day and the first trading day. UTM is calculated as (T-M*Adj3)/M*Adj3 and T and M are defined as above and Adj3 is the market movement adjustment between red herring and the first trading day.

| | UFM | UTF | UTM |
|---|---|---|---|
| N | 531 | 531 | 531 |
| Mean | -0.034. | 0.103 | 0.075 |
| Std Dev | 0.165 | 0.171 | 0.299 |
| Skewness | -0.227 | 1.976 | 1.036 |
| Kurtosis | 0.703 | 5.149 | 1.711 |
| Percentiles | | | |
| 100% | 0.53 | 0.99 | 1.27 |
| 99% | 0.33 | 0.73 | 1.04 |
| 95% | 0.22 | 0.49 | 0.60 |
| 90% | 0.17 | 0.31 | 0.47 |
| 75% | 0.07 | 0.16 | 0.22 |
| 50% | -0.02 | 0.042 | 0.20 |
| 25% | -0.12 | 0.000 | -0.105 |
| 10% | -0.26 | -0.029 | -0.255 |
| 5% | -0.35 | -0.063 | -0.338 |
| 1% | -0.47 | -0.126 | -0.452 |
| 0% | -0.54 | -0.266 | -0.536 |

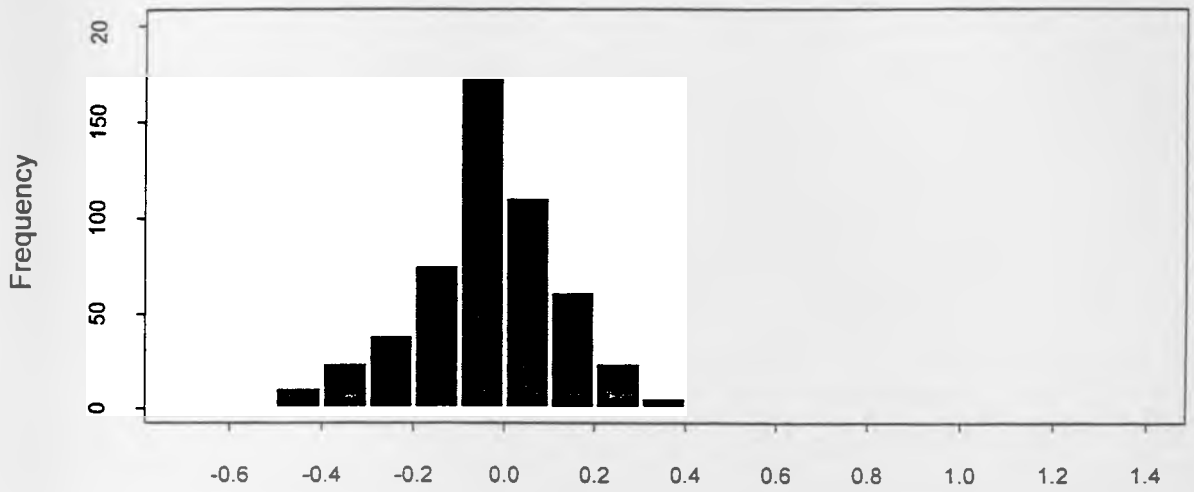


Figure 7.2.1. UFM

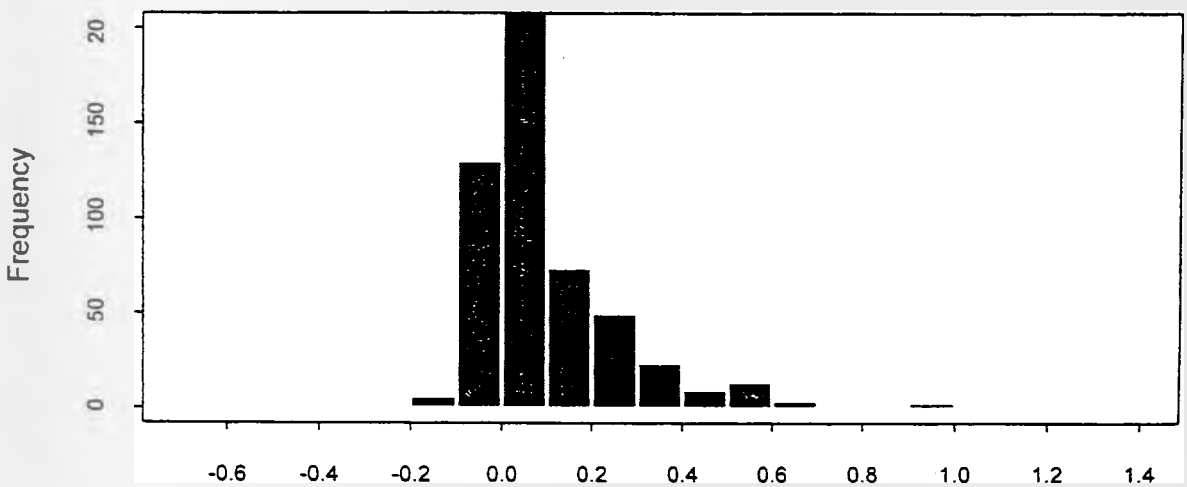


Figure 7.2.2. UTF

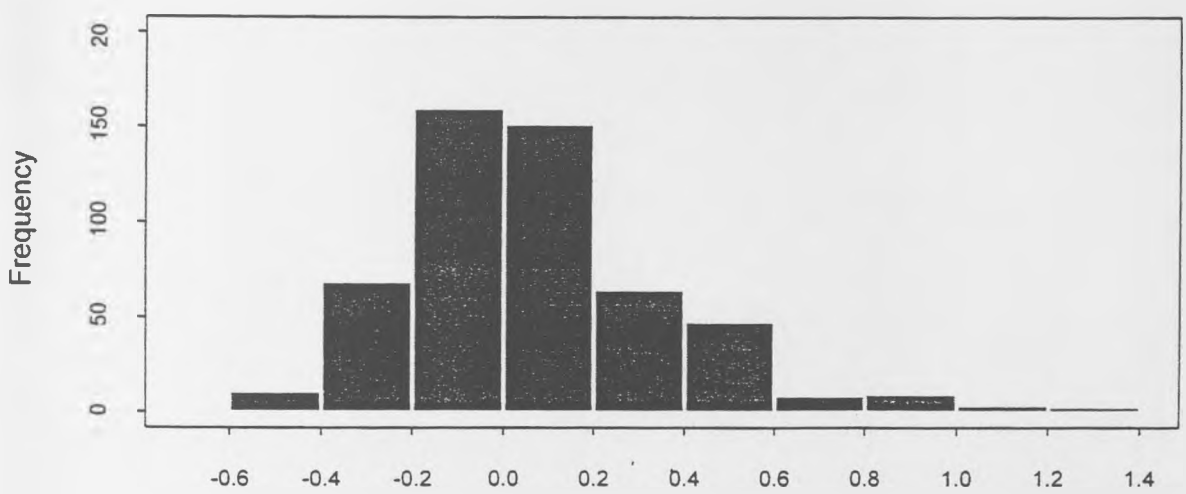


Figure 7.2.3. UTM

Table 7.2.2 lists the sample IPOs by the year of offering. One feature one can see from Table 7.2.2 is that the number of firms going public is reversibly related to risk free interest rate (For quarterly average interest rate, see Table 7.6.5). The numbers of issues offered to the public from 1988 to 1990 are the lowest, 42, 35 and 41 respectively, corresponding to the three highest annual interest rate, 6.63 percent, 8.09 percent and 7.47 percent respectively. On the other hand, 1992 and 1993 saw the largest number of firms going public, 148 and 166 respectively, corresponding to the record low interest rate in two decades, 3.55 and 3.02 percent respectively.

Table 7.2.3 summarizes the characteristics of the sample by the type of industry that IPO companies are associated with. It seems that IPOs issued by banking and heavy industries are less underpriced (6.9 and 5.8 percent respectively) in comparison with those by other two industries (12.0 percent for high-tech industry and 10.0 percent for light industry). This is in line with the findings on the same subject by Ritter (1991).

**Table 7.2.2 Summary of 531 IPOs by Year of Offering**

This table reports average UTF, UFM and UTM for each year between 1988 and 1993, where UTF=(T-F)/F, UFM=(F-M)/M, and UTM=(T-M)/M, T is the first trading day closing price, M is the mean filing price and F is the offering price. Corresponding standard deviations are in parenthesis. N is the number of issues. Market movement has been taken into account in the calculation of UTF, UFM, and UTM.

| | N | Average UTF (S.D.) | Average UFM (S.D.) | Average UTM (S.D.) |
|---|---|---|---|---|
| 1988 | 42 | 0.079 | -0.081 | -0.005 |
| | | (0.136) | (0.121) | (0.203) |
| 1989 | 35 | 0.083 | -0.029 | 0.057 |
| | | (0.094) | (0.113) | (0.190) |
| 1990 | 41 | 0.123 | 0.062 | 0.205 |
| | | (0.135) | (0.206) | (0.326) |
| 1991 | 99 | 0.131 | -0.012 | 0.127 |
| | | (0.183) | (0.143) | (0.286) |
| 1992 | 148 | 0.082 | -0.074 | 0.014 |
| | | (0.162) | (0.194) | (0.316) |
| 1993 | 166 | 0.109 | -0.026 | 0.092 |
| | | (0.195) | (0.144) | (0.308) |

**Table 7.2.3 Summary of 531 IPOs by Industry**

This table summarizes the average UTF, UFM and UTM of the sample IPOs by industry. Light industry includes apparel, appliances, cosmetic, fabric, farm product, food, jewelry, leather, multiple, office equipment, paper, plastic product, publishing, sporting goods, toys, wine, and wood product; Heavy industry includes aircraft, automotive, chemical, industrial machinery, metal product, power supplies, ships & homes, and steel; High-tech industry includes computers, electronic components, family electronics, medical instruments, pharmaceutical, photo product, R & D, scientific instruments, semiconductors and telecommunications equipment; and Banking industry includes commercial banks. UTF = (T-F)/F, UFM =(F-M)/M and UTM=(T-M) where T is the first trading day closing price, F is the final filing price and M is the mean filing price. N in column two is the number of issues. Calculations of UFM, UTF and UTM have taken into account the effect of market movement;

| Type of Industry | N | UTF (S.D.) | UFM (S.D.) | UTM (S.D.) |
|---|---|---|---|---|
| Light Industry | 123 | 0.100 (0.174) | -0.020 (0.142) | 0.088 (0.286) |
| Heavy Industry | 70 | 0.058 (0.122) | -0.065 (0.160) | -0.002 (0.259) |
| High-Tech Industry | 319 | 0.115 (0.180) | -0.033 (0.178) | 0.089 (0.316) |
| Banking Industry | 19 | 0.069 (0.111) | -0.028 (0.050) | 0.040 (0.125) |

## 7.3. Results on Interest Rate and Underpricing

The theoretical work in Chapter Six proved a positive correlation between underpricing and risk free interest rate, a key indicator of the overall financial market. This section will examine the extent to which risk free interest rate affects the degree of underpricing as interpreted by three differently defined definitions in this dissertation. The hypotheses was formulated as follow:

- $H_0$: IPO underpricing is unrelated to risk free interest rate.
- $H_1$: IPO underpricing is positively related to risk free interest rate.

To test the hypothesis that risk free interest rates are higher for underpriced

issues than for overpriced issues, an one-side two-sample t-tests is employed to compare the interest rates accompanying both underpriced issues and overpriced issues. Since the standard deviation of interest rates that accompanying the underpriced and overpriced issues are different, the approximate t-statistic was used and it has the following form;

$$t = \frac{\overline{IU} - \overline{IO}}{\sqrt{w1 + w2}} = \frac{4.693 - 4.306}{0.161} = 2.404,$$

where $\overline{IU}$ is the average interest rate for the underpriced issues, $\overline{IO}$ is the average interest rate for the overpriced issues, $w1 = s_1^2/n_1$ and $w2 = s_2^2/n_2$. Here, $s_1$ and $s_2$ are estimated standard deviations of $\overline{IU}$ and $\overline{IO}$ respectively; $n_1 = 394$ and $n_2 = 137$ are numbers of underpriced and overpriced issues respectively. The corresponding one-sided p-value in comparing interest rates accompanying positive and negative initial return is 0.017. Thus, it can be concluded that the risk free interest rates are higher when the underpriced shares are issued than when the overpriced shares are issued. In other words, higher interest rate is more likely to bring forth underpriced IPOs. Based on the above test, the null hypothesis that the interest rates accompanying both IPOs with positive or negative return are the same can then be rejected.

The similar procedures were carried out for the other two underpricing definitions, and all the results are summarized in Table 7.3.1. The second and third rows, UTF and UTM, show that there is a distinct difference between the underpriced issues and overpriced issues. The results suggest that higher interest rate is more likely to produce underpriced shares in terms of the changes from mean filing price or offer price to the first trading day closing price. Such a finding implies that interest rate does play a role in forming the first trading day closing price, because investors who buy IPOs in the secondary market tend to compare their purchases of IPOs with other risk free investment vehicles.

**Table 7.3.1. Comparison of Interest Rates for Underpriced and Overpriced IPOs**

This table compares average interest rates between the issues with positive initial returns and those with negative initial returns defined by UFM, UTF and UTM respectively. UFM is calculated as (F-M)/M, where F is the final filing price and M is the mean initial filing price. UTF is calculated as (T-F)/F, where T is the first trading day closing price and F is the final filing price. UTM is calculated as (T-M)/M, where T and M are the same as above. The calculations of UFM, UTF and UTM have taken into account the market movement. The t-statistic is calculated as $(\bar{I}^- - \bar{I}^+)/se$, where $\bar{I}^-$ and $\bar{I}^+$ are respectively average interest rates when the offers with negative returns and offers with positive returns occurred; $se$ is the standard error of $(\bar{I}^- - \bar{I}^+)$. The corresponding p-value is one sided with alternative hypothesis being that the interest rate is higher when the offers result in negative initial returns than when offers result in positive initial returns.

| | Underpriced Issues Mean (S.D.) | Overpriced Issues Mean (S.D.) | t-statistic | p-value |
|---|---|---|---|---|
| UFM | 4.647%(1.77%) | 4.560%(1.77%) | 0.553 | 0.581 |
| UTF | 4.693%(1.83%) | 4.306%(1.55%) | 2.404 | 0.017 |
| UTM | 4.750%(1.81%) | 4.403%(1.70%) | 2.261 | 0.024 |

On the other hand, from the first row (UFM), we can see that the average interest rates are comparable between the group whose offer price was higher than the mean initial filing price and the group whose offer price was lower than the mean initial filing price under the definition of UFM. The underpriced group has an average interest rate of 4.65 percent which is not much different from the average interest rate of 4.56 percent of the overpriced group. Such a finding suggests that interest rate has already been taken into consideration prior to determination of the initial filing price. This is because the time span between initial filing price and offer price determination is only two to three weeks, and in most cases interest rate would not experience dramatic change during such a short period of time. For this reason, the impact of interest rate on initial filing price and final offer price is not significantly different.

To test whether interest rates are linearly related to initial returns, the following three models were considered.

$$UTF = \alpha_1 + \beta_1 INX + \varepsilon_1, \tag{7.1}$$

$$UFM = \alpha_2 + \beta_2 INX + \varepsilon_2, \tag{7.2}$$

$$UTM = \alpha_3 + \beta_3 INX + \varepsilon_3, \tag{7.3}$$

where $INX$ is the interest rate accompanying each IPO issuing and $\varepsilon$ is the random disturbance. Tables 7.3.2 to 7.3.4. presented results from the regression analysis of models (7.1) to (7.3). These models are trying to test whether there is a linear relationship between UTF, UFM, UTM and interest rates. One can see that none of these models are statistically significant. This does not contradict the previous finding that on the average, interest rates corresponding to IPOs with positive performance are higher than those corresponding to IPOs with negative performance. This is due to there are higher variation in initial returns corresponding to low interest rate than in initial returns corresponding to high interest rates. But after adjusting for the different variation in interest rates corresponding to positive and negative performance IPOs, there are still significant differences existing between interest rates of the positive and negative performance IPOs. Based on the above results, a linear relationship between interest rates and initial performance of IPOs can not be established.

Figures 7.3.1. to 7.3.3. showed the diagnostic residual plots for models 7.1. to 7.3. respectively. There is slight heteroscedasticity existed in model 7.1, but transformation of the data did not improve the fit of the model. The other plots show random behavior of the residuals, suggesting there is no nonlinearity, heteroscedasticity existed in the data for models 7.2 and 7.3. The chi-square tests for heteroscedasticity are all not statistically significant.

**Table 7.3.2. Regression results for model (7.1.)**

This table presents results from the regression analysis of model $Y = \alpha_1 + \beta_1 INX$, where $Y$=UTF and $INX$=interest rate. UTF is calculated as (T-F)/F, where T is the first trading day closing price and F is the final filing price. Interest rates were the rates at the time when the IPOs were issued. UTF has been adjusted for market movement.

| | $\alpha_1$ | $\beta_1$ | $R^2$ | N | F-statistic | Significance of F |
|---|---|---|---|---|---|---|
| Estimate of Coefficient | 0.103 | -0.0002 | 0.00% | 531 | 0.00 | 0.9661 |
| Standard Error | 0.021 | 0.004 | | | | |

**Table 7.3.3. Regression results for model (7.2.)**

This table presents results from the regression analysis of model $Y = \alpha_2 + \beta_2 INX$, where $Y$=UFM and $INX$=interest rate. UFM is calculated as (F-M)/M, where M is the mean initial filing price and F is the final filing price. Interest rates were the rates at the time when the IPOs were issued. UFM has been adjusted for market movement.

| | $\alpha_2$ | $\beta_2$ | $R^2$ | N | F-statistic | Significance of F |
|---|---|---|---|---|---|---|
| Estimate of Coefficient | -0.061 | 0.006 | 0.40% | 531 | 2.11 | 0.1473 |
| Standard Error | 0.020 | 0.004 | | | | |

**Table 7.3.4. Regression results for model (7.3.)**

This table presents results from the regression analysis of model $Y = \alpha_3 + \beta_3 INX$, where $Y$=UTM and $INX$=interest rate. UTM is calculated as (T-M)/M, where T is the first trading day closing price and M is the mean initial filing price. Interest rates were the rates at the time when the IPOs were issued. UTM has been adjusted for market movement.

| | $\alpha_3$ | $\beta_3$ | $R^2$ | N | F-statistic | Significance of F |
|---|---|---|---|---|---|---|
| Estimate of Coefficient | 0.050 | 0.006 | 0.10% | 531 | 0.56 | 0.4527 |
| Standard Error | 0.036 | 0.007 | | | | |

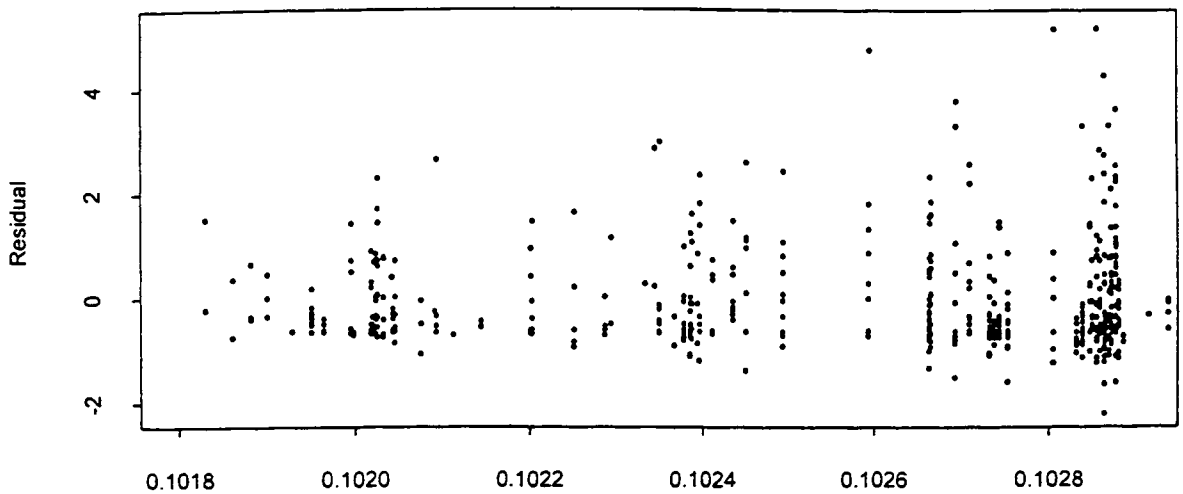


Figure 7.3.1. Fitted Values of UTF

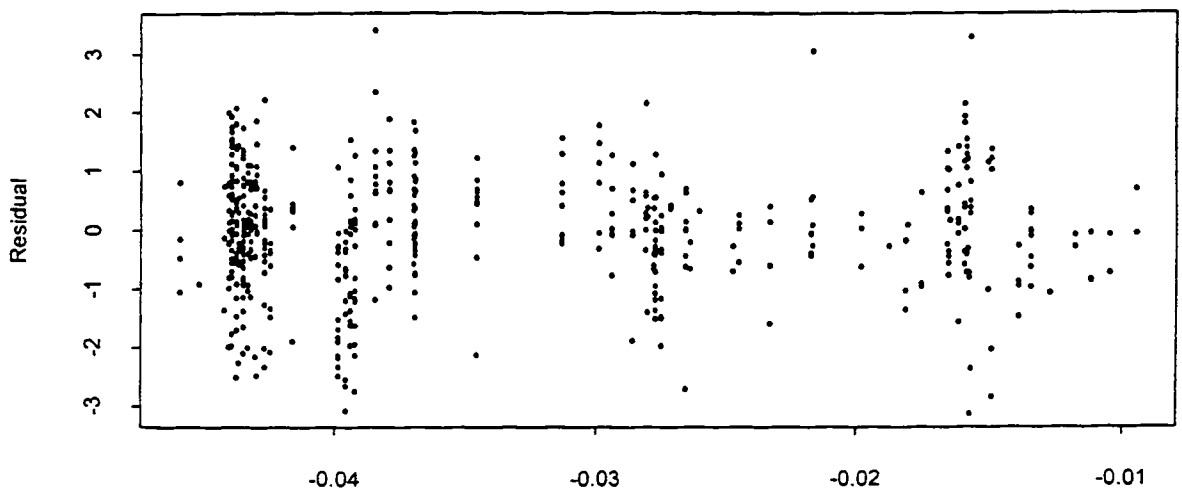


Figure 7.3.2. Fitted Values of UFM

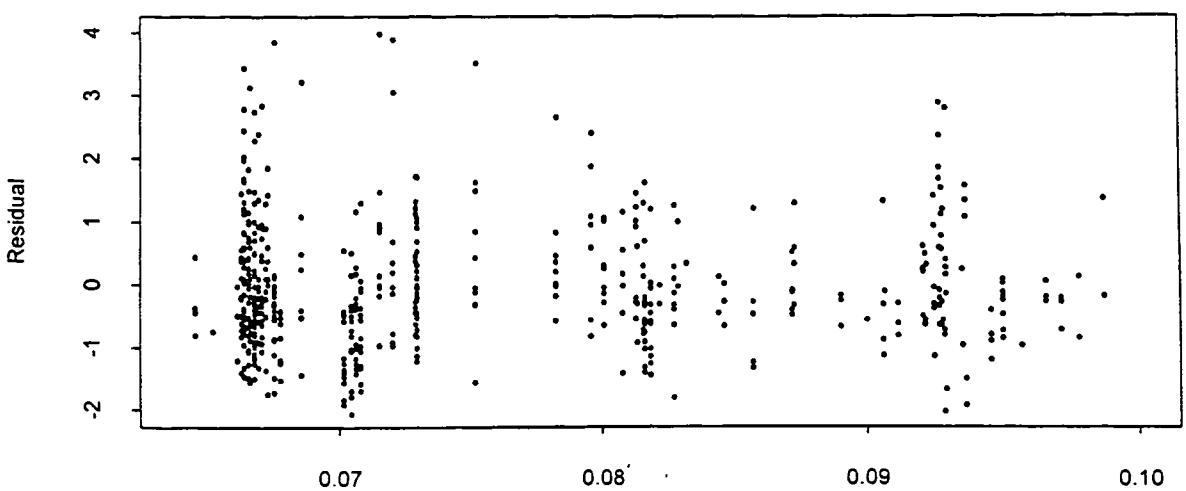


Figure 7.3.3. Fitted Values of UTM

### 7.4. Results on Demand Index and Underpricing

Considering the difficulty of obtaining subscription information from underwriters which is usually considered as confidential, a demand index is created to describe the demand for IPOs. The demand index, UFM, is defined as the position of the final offering price relative to the mean of the high and low initial filing price. In this section, the relationship between underpricing, UTF, and demand index will be examined. The hypothesis is formulated as follow:

- $H_0$: IPO underpricing, UTF, is unrelated to the market demand index, UFM.
- $H_1$: IPO underpricing, UTF, is positively related to the market demand index, UFM.

Table 7.4.1 presents the average initial returns by the different demand index, UFM. In this table, IPOs were classified into five groups based on their UFM values. The six groups have UFM values that are UFM $\leq$ -15%, -15% $<$ UFM $\leq$ 0, 0$<$ UFM $\leq$ 10%, 10%$<$ UFM $\leq$ 20% and 20% $<$ UFM respectively. The corresponding mean UTF were calculated along with their standard deviations. Table 7.4.1. suggests that a higher level of demand index is associated with a higher initial return.

**Table 7.4.1. Summary of Initial Performance by Demand Index**
The demand index UFM is calculated as (F-M)/M and UTF is calculated as (T-F)/F, where T is the first trading day closing price, F is the offering price and M is the mean filing price. The main body of the table reports the average initial return (UTF) and its standard deviation by the different levels of UFM. UFM and UTF have been adjusted for market movement.

| | | UFM | | | | |
|---|---|---|---|---|---|---|
| | | $\leq$-15% | -15 - 0% | 0 - 10% | 10 - 20% | 20%+ |
| | N | 105 | 220 | 111 | 62 | 33 |
| UTF | Mean | 1.92% | 8.10% | 10.5% | 22.7% | 27.1% |
| | S.D. | 6.97% | 16.2% | 15.2% | 19.0% | 22.8% |

Table 7.4.2. shows the percentage of issues with positive and negative performance by the five groups defined for Table 7.4.1. Table 7.4.2. shows that there is a trend that the percentage of issues with a positive performance increases as the demand index increases. In Table 7.4.2, we can compute that when the demand index is greater than zero, which means that the final offering price is greater than the mean initial filing price, the number of IPO issues with negative UTF initial performance is about 41 and the number of issues with positive initial performance is about 165. When the demand index is smaller than zero, the number of issues with negative initial returns is 96 and the number of issues with positive initial return is 229 In other words, when the demand index is larger than zero, there are 80 percent underpriced issues and 20 percent overpriced issues, and when the demand index is smaller than zero, their percentages decreases to 70 percent and increases to 30 percent respectively.

**Table 7.4.2. Percentage of Issues with a Positive Performance by Demand index**

The demand index UFM is calculated as (F-M)/M and Initial performance is evaluated by UTF=(T-F)/F, where T is the first trading day closing price and F is the filing price and M is the mean initial filing price. N reports the total number of issues by UFM. The last two rows report the percent of issues with a negative and positive performance respectively by UFM. UTF and UFM have been adjusted for market movement.

| | Demand index UFM | | | | |
|---|---|---|---|---|---|
| UTF | ≤-15% | -15 - 0% | 0 - 10% | 10 - 20% | 20%+ |
| N | 105 | 220 | 111 | 62 | 33 |
| Percent of Issues with Negative Performance | 40.0% | 24.6% | 27.0% | 8.06% | 18.2% |
| Percent of Issues with Positive Performance | 60.0% | 75.5% | 73.0% | 91.94% | 81.8% |

Based upon Table 7.4.2., it becomes possible to estimate the probability of

drawing a winning issue accordingly. When demand index is greater than zero, the point estimate of the probability of drawing a winning issue, $\hat{p}$, is

$$\hat{p} = \frac{165}{206} = 0.80.$$

The standard error of $\hat{p}$ can be estimated as

$$\hat{\sigma}_p = \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} = \sqrt{\frac{0.80 \times 0.20}{206}} = 0.028.$$

Because $n = 206$ is large, we can use normal approximation to derive a 95 percent confidence interval for the probability of drawing a winning issue when demand index is greater than zero. The 0.975-percentile z-value is about 1.96, thus the desired confidence interval is

$$(0.80 - 1.96 \times 0.028,\ 0.80 + 1.96 \times 0.028) = (0.75,\ 0.85).$$

This strongly indicates that when the demand index is greater than zero, the probability of drawing a winning issue is very high.

Similarly, we can obtain a 95 percent confidence interval for the probability of drawing a winning issue when demand index is smaller than zero. The point estimate of drawing a winning share in this case is 229/325=0.70, its standard error estimate is

$$\sqrt{\frac{0.70 \times 0.30}{325}} = 0.025.$$

Therefore, a 95 percent confidence interval for the probability of drawing a winning share is $(0.70 - 1.96 \times 0.025,\ 0.70 + 1.96 \times 0.005) = (0.65,\ 0.75)$. One can see that the probability of drawing a winning issue is significantly higher when the demand index, UFM is positive than when the demand index is negative.

To obtain a more quantitative relationship between initial return and demand index, let's consider the following empirical model:

$$UTF = \alpha_1 + \beta_1 * UFM + \varepsilon. \tag{7.4}$$

Here, $UTF$ is calculated as: $UTF = (T-F)/F$, and $UFM = (F-M)/M$ where $T$ is the closing price on the first trading day, F is the issuing firm's offer price and M is the mean of the initial filing price and $\varepsilon$ is the random disturbance. UTF and UFM have been adjusted for market movement.

Tables 7.4.3 presents the regression results for model 7.4. A positive significant relationship is found between the demand index and initial performance. To evaluate the appropriateness of model (7.4), the studentized residuals are plotted against the predicted values of UTF and are shown on Figure 7.4.1. The studentized residual is calculated as $e_i/S$, where $e_i$ is the difference of the observed and the fitted UTF and $S$ is its standard deviation. Figure 7.4.1. shows that the variance of the residuals tend to increase as UTF increases. The Chi-square test of the first and second moment specification has a p-value less than 0.0001 which confirms the heteroscedasticity suggested by Figure 7.4.1.

**Table 7.4.3. Regression results for model 7.4**
This table presents regression results for 531 issues from the model $UTF = \alpha + \beta * UFM$, where $UTF$= (T-F)/F and UFM=(F-M)/M, where T is the first trading day closing price, F is the final filing price and M is the mean filing price. UFM and UTF have been adjusted for the market movement.

| | $\alpha_1$ | $\beta_1$ | $R^2$ | N | F-statistic | Significance of F |
|---|---|---|---|---|---|---|
| Estimate of Coefficient | 0.116 | 0.391 | 14% | 531 | 88.69 | 0.0001 |
| Standard Error | 0.007 | 0.042 | | | | |

One way to overcome the heteroscedasticity existed is by way of a data transformation. The transformation that produces a relatively constant variance of the errors is a reciprocal transformation of the dependent variable. The reciprocal transformation of (1+UTF) leads to the following model:

$$\frac{1}{1+UTF} = \alpha_2 + \beta_2 * UFM + \varepsilon. \tag{7.5}$$

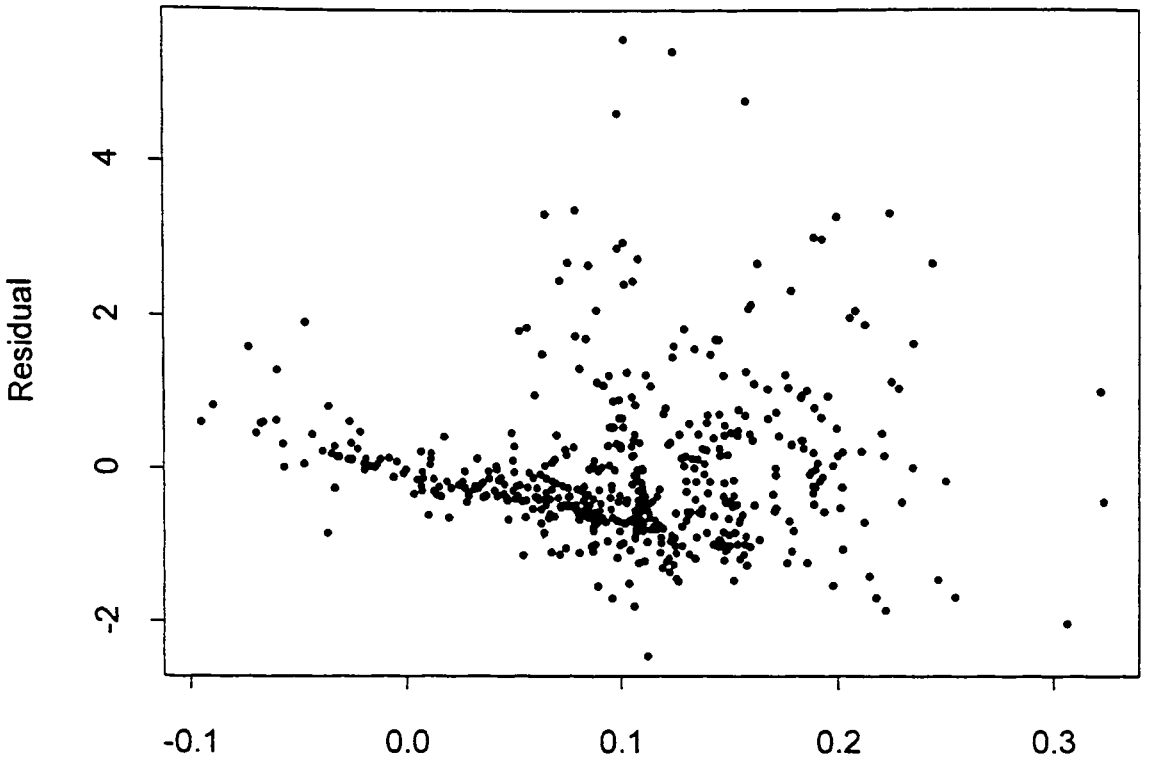


Figure 7.4.1. Fitted Values of UTF

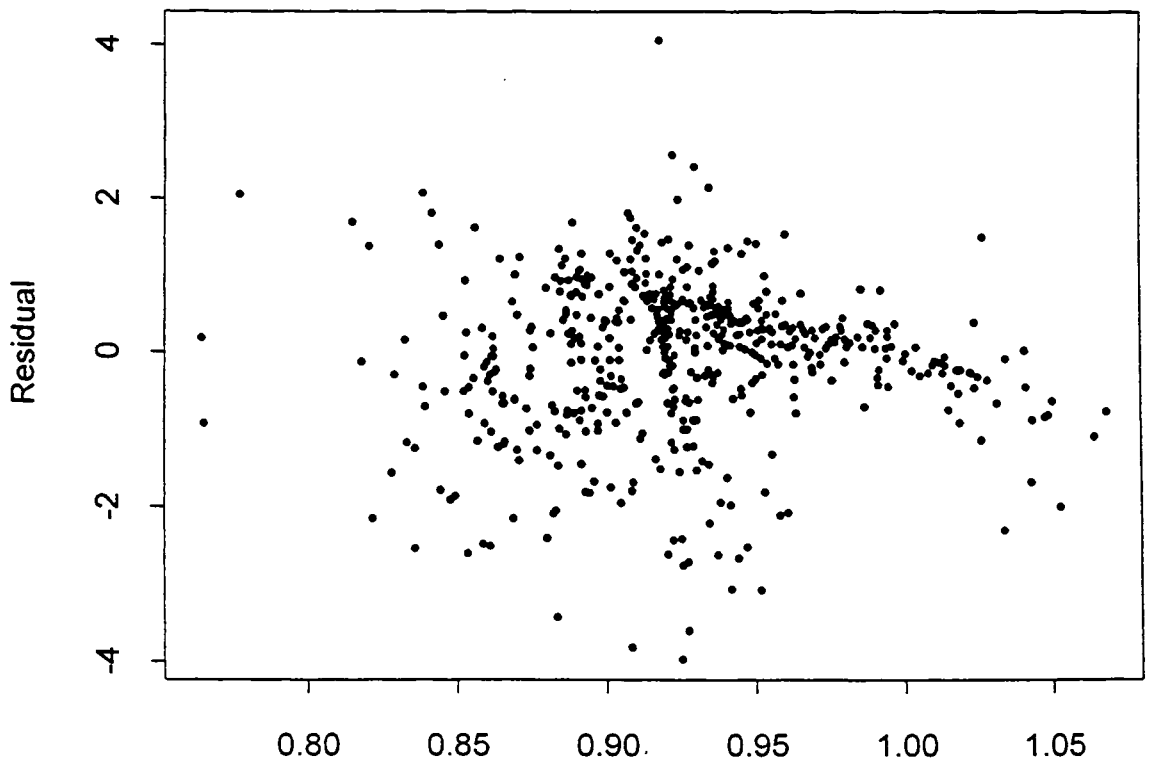


Figure 7.4.2. Fitted Values of 1/(1+UTF)

Figure 7.4.2. shows the diagnostic plot of the residuals against the fitted dependent variable, namely, $1/(1+UTF)$. The behavior of the residuals looks rather random around zero. There is no obvious nonlinear curvature exhibited in the data. Even though the Chi-square test for heteroscedasticity produces a p-value of 0.003, it is mainly caused by the two values with the smallest predicted values as shown on Figure 7.4.2. The model (7.5) is then refitted deleting the two outliers with the smallest predicted values. The resulting residual plot looks satisfactory. The corresponding Chi-square test for heteroscedasticity has a p-value of 0.06, which suggests that one can say that the residual variance does not change as the dependent variable increases. Table 7.4.4. shows a highly significant relationship between 1/(1+UTF) and UFM. The R-square equals to 18%. Hence, the null hypothesis that there is no relationship between initial return and demand index, UFM, can be rejected.

One may use model (7.5) to obtain an estimate of the possible initial return once the final filing price is known. For instance, if an issuing firm's final offering price is 1.5 times as large as the mean filing price, M, (that is when UFM=0.5), we should expect about 29.4 percent return in the IPO's initial performance from the regression result in Table 7.4.4.

It is of interest to include in model (7.5) a second regressor based on the spread of the upper and lower red herring price (initial filing price). An attempt was made to define the spread as D=(F-M)/(U-L), where as before, F is the final filing price, M is the mean of the upper and lower red herring price, U and L are the upper and lower red herring price respectively. Issues that have the same upper (U) and lower (L) red herring price are excluded when defining D. It turns out that UFM and D are highly correlated (correlation=0.94). Including D as an additional regressor in this case would produce a severe collinearity problem.

**Table 7.4.4. Regression results for model 7.5**

This table presents regression results for 430 issues from the model $1/(1+UTF) = \alpha + \beta UFM$, where $UTF$= (T-F)/F and UFM=(F-M)/M, where T is the first trading day closing price, F is the final filing price and M is the mean filing price. UTF and UFM have been adjusted for the market movement.

| | $\alpha_2$ | $\beta_2$ | $R^2$ | N | F-statistic | Significance of F |
|---|---|---|---|---|---|---|
| Estimate of Coefficient | 0.915 | -0.284 | 16% | 531 | 99.79 | 0.0001 |
| Standard Error | 0.005 | 0.028 | | | | |

## 7.5. Results on Total Proceeds and Underpricing

In Chapter Six, equation 6.7 suggests that underpricing is inversely proportional to the total proceeds. Thus, the following hypothesis is formulated:

- $H_0$: IPO underpricing is unrelated to the total proceed.
- $H_1$: IPO underpricing is positively related to the total proceed.

Table 7.5.1 shows the average UTF, UFM and UTM and their standard deviations according to proceeds by group. All the IPOs were divided into four groups by the amount of total proceed. For instance, the first column in Table 7.5.1 corresponds to proceeds that are less than or equal to 10 million US dollars. To test the null hypothesis proposed at the beginning of this chapter, let's consider the following models:

$$UTF = \alpha_1 + \beta_1(1/P) + \varepsilon_1, \tag{7.6}$$

$$UFM = \alpha_2 + \beta_2(1/P) + \varepsilon_2, \tag{7.7}$$

$$UTM = \alpha_3 + \beta_3(1/P) + \varepsilon_3, \tag{7.8}$$

where $UTF = (T - F)/F$, $UFM = (F - M)/M$, $UTM = (T - M)/M$ and $P$ is total proceeds defined as

$$\frac{\text{total shares issued globally} \times \text{offer price}}{1,000,000},$$

$\alpha_i$s are constants in the regression models, $\beta_i$s are regression coefficients and $\varepsilon$s are the random disturbance. Table 7.5.2 presents the regression results. From the last column in Table 7.5.2, one can see that none of the models is statistically significant. Figures 7.5.1, 7.5.2, and 7.5.3 show plots of the residuals against the predicted value of UTF, UFM and UTM of models 7.6, 7.7, and 7.8 respectively. All the residual plots (Figures 7.5.1 to 7.5.3) show nonnormal behavior of the random error. The distribution of the random errors for model 7.6 to 7.8 seem skewed. Logarithm transformation of the total proceeds was carried out but did

not normalize the models' random error or produce a better fit of the data to the linear regression models. Therefore, we cannot reject the null hypothesis that underpricings are not related to total proceeds from the above discussion.

**Table 7.5.1. Summary of UTF, UFM and UTM by Total Proceeds**
This table presents the average of UTF, UFM and UTM along with their standard deviation by total proceeds, where $UTF$= (T-F)/F, UFM=(F-M)/M, UTM=(T-M)/M, and T is the first trading day closing price, F is the final filing price and M is the mean filing price. UFM, UTF and UTM have been adjusted for the market movement. IPOs were divided into four groups by the amount of total proceed. The first group has total proceed less than 10 million dollars. The second group has total proceed between 10 and 20 million dollars. The third group has total proceed between 20 and 40 million dollars. The last group has total proceed greater than 40 million dollars. N is the number of IPO in each group.

| | Total Proceeds in million US dollars | | | |
|---|---|---|---|---|
| | 0 - 10 | 10 - 20 | 20 - 40 | 40+ |
| N | 139 | 130 | 148 | 114 |
| UTF | 0.1058 | 0.0984 | 0.1161 | 0.0858 |
| | (0.20) | (0.17) | (0.16) | (0.15) |
| UFM | -0.0414 | -0.0838 | 0.0044 | -0.0194 |
| | (0.15) | (0.17) | (0.15) | (0.18) |
| UTM | 0.0657 | 0.0179 | 0.1324 | 0.0788 |
| | (0.28) | (0.31) | (0.29) | 0.31) |

**Table 7.5.2. Regression results for 531 issues for models 7.6 to 7.8**
This table presents regression results for models 7.6 to 7.8. UTF= (T-F)/F. UFM=(F-M)/M, UTM=(T-M)/M, and T is the first trading day closing price. F is the final filing price and M is the mean filing price. UTF, UFM and UTM have been adjusted for the market movement.

| | $\alpha_i$ | $\beta_i$ | $R^2$ | F-statistic | Significance of F |
|---|---|---|---|---|---|
| | | | $UTF = \alpha_1 + \beta_1 * (1/P)$ | | |
| Estimate of Coefficient | 0.098 | 0.052 | 0.6% | 0.309 | 0.5787 |
| Standard Error | 0.011 | 0.093 | | | |
| | | | $UFM = \alpha_2 + \beta_2 * (1/P)$ | | |
| Estimate of Coefficient | -0.035 | 0.008 | 0.0% | 0.009 | 0.9239 |
| Standard Error | 0.010 | 0.090 | | | |
| | | | $UTM = \alpha_3 + \beta_3 * (1/P)$ | | |
| Estimate of Coefficient | 0.074 | 0.010 | 0.0% | 0.004 | 0.9523 |
| Standard Error | 0.019 | 0.163 | | | |

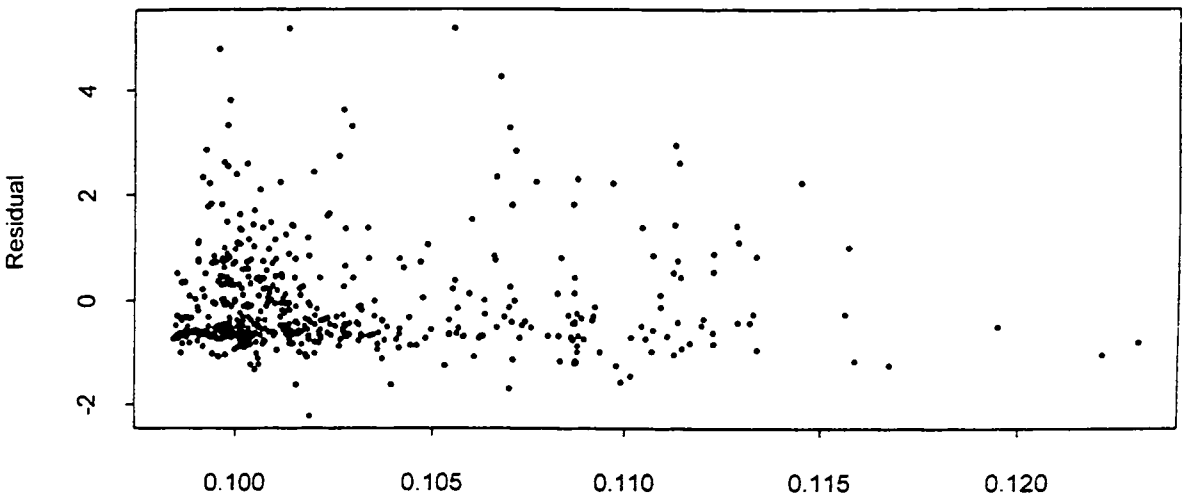


Figure 7.5.1. Fitted Values of UTF

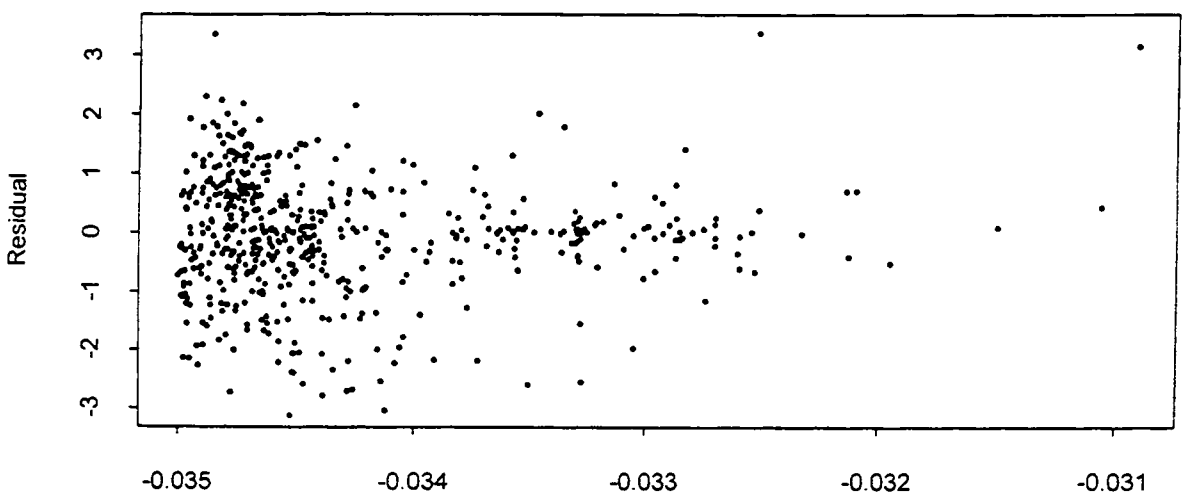


Figure 7.5.2. Fitted Values of UFM

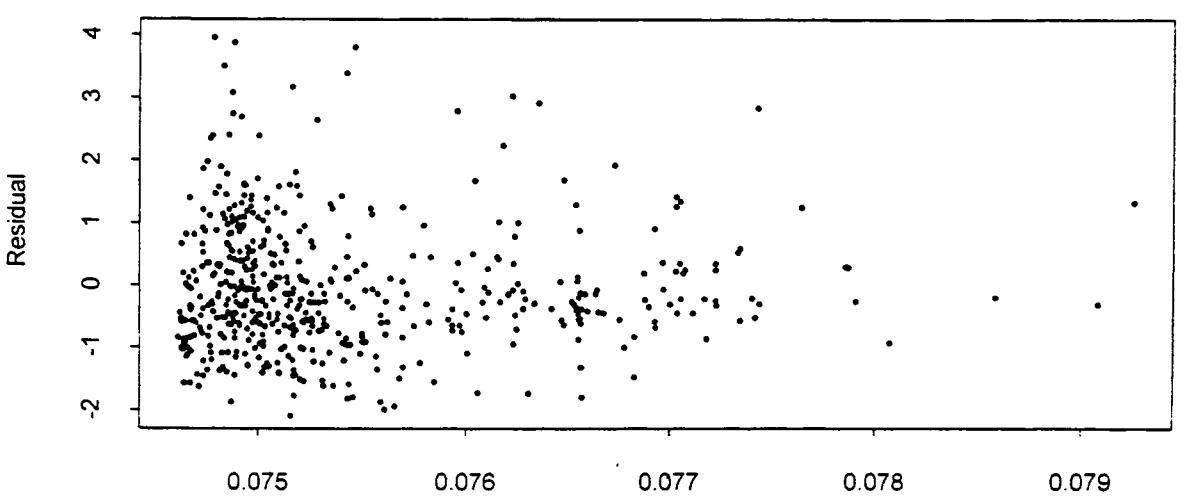


Figure 7.5.3. Fitted Values of UTM

## 7.6. Results on Hot Market and Cold Market

### 7.6.1. Underpricing in Hot/Cold Market

In this section, we will examine how underpricing differs between a hot market and a cold market by comparing underpricing between the IPOs issued from January, 1988 through March, 1991 and those issued from April, 1991 through December, 1993. To test whether initial returns are related to market condition, the following hypothesis is formulated:

- $H_0$: Initial return, UTF, is the same regardless of the market condition.
- $H_1$: Initial return, UTF, is higher in the hot market than in the cold market.

From Table 7.6.1., one can see that the number of IPOs issued in each quarter from 1988 to the first quarter in 1991 stayed below 20 with most of them below 10 and there was a sharp rise in the number of IPOs after the second quarter of 1991. The average number of IPOs from the second quarter of 1991 to the last quarter of 1993 was about 40. It is reasonable then to define the first thirteen quarters as a cold market and the rest as a hot market. Table 7.6.2 shows the average initial returns in the hot and cold market for the three definitions and their standard deviations. Table 7.6.3. shows the percentage of IPO issues that are underpriced in the hot and cold market respectively. From Table 7.6.3, one can see that the percentage of IPO issues with positive performance in the whole sample for UFM is similar in both the cold and hot markets. But the percentage of IPO issues with positive performance in the whole sample for UTF and UTM are significantly different in the cold and hot market. Percentage of underpriced issues by UTF in the cold market is 82 percent, which is significantly higher than that in the hot market which is 71 percent at significance level of 0.02.

From Table 7.6.2., it is evident that there are no significant differences between the hot and cold market in terms of initial returns for any stage, while as in Table 7.6.3. one can see that the percentage of underpriced issues is significantly lower

in the hot market than in the cold market.

From earlier discussions, we know that in the cold market issue volumes are small which should make supplies scarce. However, because interest rate is high, investors are less motivated to invest in the volatile IPO market thus making demand to shrink. As a result, total wealth available to be invested in the IPO market remains small. The sluggish market condition results in fewer firms to offer IPOs.

In the hot market where the interest rate is low, people are more willing to invest in the IPO market, thus the total wealth available to the IPO market is larger. Consequently, high demand motivates more firms to make initial offerings.

The cold market is associated with small supply and proportionally small demand, and the hot market is associated with large demand and supply. Therefore, the ratio of the total wealth invested in the IPO market and total number of issues in the cold market is similar to that in the hot market. As a result, the average initial return turns out to be similar in both hot and cold market.

This result is significant in proving the author's theoretical work that underpricing is an incentive for issuers to stimulate demand in the cold market condition. At the stage of initial filing price, which is described by UFM and UTM, without artificial effort the ratio of total supply and demand in cold market is similar to that in the hot market. However, at the offer price stage, depending on the cold market condition, more issuers lower offer price or further discount their IPOs to stimulate demand. Such effort causes instant rise of percentage of underpriced issues and eventually changes the market condition, producing higher percentage of underpriced issues in the cold market than in the hot market in terms of UTF. It can be concluded that when wealth available to be invested in IPOs is limited in the cold market, more issuing firms may choose to underprice their offering shares to attract investors. While in the hot market, this may not be the case.

Now, in order to quantify the average initial return and number of firms going public, let's consider the following models:

$$MUTF = \alpha_1 + \beta_1 * S + \varepsilon_1 \tag{7.9}$$

$$MUFM = \alpha_2 + \beta_2 * S + \varepsilon_2 \tag{7.10}$$

$$MUTM = \alpha_3 + \beta_3 * S + \varepsilon_3 \tag{7.11}$$

where MUTF, MUFM and MUTM are the averages of UTF, UFM and UTM respectively in each quarter, S is the number of IPOs in each quarter for the time period our data set covers and the $\varepsilon$s are random disturbance. Tables 7.6.4 shows the regression results for the above models. None of the above models is statistically significant. Figures 7.6.1 to 7.6.3 show the residuals versus the predicted MUTF, MUFM and MUTM respectively. There are no suggestions in any of these figures that heteroscadasticity and non-linearity existed.

**Table 7.6.1 Number of offerings issued, mean UTF, UFM and UTM and their standard deviation in each quarter**

This table reports number of IPOs issued in each calendar quarter from 1988 to 1993. quarterly mean of UTF, UFM, UTM and their standard deviation. UTF, UFM and UTM have been adjusted for the market movement.

| | | Number | UTF | | UFM | | UTM | |
|---|---|---|---|---|---|---|---|---|
| Year | Quarter | of IPOs | Mean | S.D. | Mean | S.D. | Mean | S.D. |
| | 1 | 10 | 0.108 | 0.152 | -0.035 | 0.107 | 0.072 | 0.205 |
| 1988 | 2 | 11 | 0.064 | 0.124 | -0.078 | 0.115 | -0.014 | 0.201 |
| | 3 | 10 | 0.073 | 0.114 | -0.027 | 0.060 | 0.043 | 0.112 |
| | 4 | 11 | 0.072 | 0.164 | -0.174 | 0.136 | -0.108 | 0.242 |
| | 1 | 6 | 0.125 | 0.140 | -0.065 | 0.111 | 0.060 | 0.242 |
| 1989 | 2 | 13 | 0.073 | 0.064 | -0.046 | 0.063 | 0.025 | 0.103 |
| | 3 | 4 | 0.055 | 0.117 | 0.032 | 0.181 | 0.098 | 0.285 |
| | 4 | 12 | 0.082 | 0.093 | -0.012 | 0.134 | 0.076 | 0.220 |
| | 1 | 9 | 0.134 | 0.131 | -0.002 | 0.267 | 0.157 | 0.404 |
| 1990 | 2 | 18 | 0.159 | 0.151 | 0.098 | 0.206 | 0.291 | 0.371 |
| | 3 | 10 | 0.052 | 0.086 | 0.027 | 0.125 | 0.079 | 0.137 |
| | 4 | 4 | 0.114 | 0.136 | 0.125 | 0.247 | 0.239 | 0.198 |
| | 1 | 10 | 0.186 | 0.242 | -0.078 | 0.157 | 0.088 | 0.252 |
| 1991 | 2 | 30 | 0.086 | 0.151 | -0.038 | 0.142 | 0.053 | 0.253 |
| | 3 | 26 | 0.117 | 0.154 | -0.019 | 0.150 | 0.108 | 0.291 |
| | 4 | 33 | 0.167 | 0.207 | 0.037 | 0.123 | 0.220 | 0.305 |
| | 1 | 49 | 0.120 | 0.198 | 0.030 | 0.154 | 0.165 | 0.333 |
| 1992 | 2 | 45 | 0.029 | 0.079 | -0.164 | 0.176 | -0.136 | 0.217 |
| | 3 | 25 | 0.044 | 0.102 | -0.175 | 0.154 | -0.138 | 0.189 |
| | 4 | 29 | 0.136 | 0.202 | -0.020 | 0.207 | 0.123 | 0.344 |
| | 1 | 34 | 0.117 | 0.145 | 0.001 | 0.137 | 0.123 | 0.237 |
| 1993 | 2 | 36 | 0.103 | 0.139 | -0.013 | 0.150 | 0.095 | 0.255 |
| | 3 | 36 | 0.170 | 0.234 | -0.012 | 0.165 | 0.181 | 0.407 |
| | 4 | 60 | 0.071 | 0.216 | -0.056 | 0.123 | 0.018 | 0.293 |

**Table 7.6.2. Initial return in a cold and hot market**

In the data set, the cold market started in the first quarter in 1988 and lasted until the first quarter of 1991, during which period the average number of IPOs issued in each month was less then 20. The hot market started in the second quarter of 1991 and lasted to the end of 1993. The first row presents the number of issues in the cold/hot market and their respective average initial return calculated as UFM=(F-M)/M, where F is the final filing price and M is the mean initial filing price. The two-tailed p-values from t-tests comparing initial returns are reported in the last column. The second row presents comparison between initial returns calculated as UTF=(T-F)F, where T is the first trading day closing price and F is the final filing price. The last row presents a comparison between initial returns gained in each of the cold and hot market calculated as UTM=(T-M)/M, where T is the same as above and M is the mean initial filing price. UTF, UFM and UTM have been adjusted for market movement.

| | Cold Market | | | Hot Market | | | |
|---|---|---|---|---|---|---|---|
| | N | Mean | S.D. | N | Mean | S.D. | p-value |
| UFM | 128 | -0.020 | 0.164 | 403 | -0.039 | 0.165 | 0.28 |
| UTF | 128 | 0.103 | 0.138 | 403 | 0.103 | 0.180 | 0.99 |
| UTM | 128 | 0.086 | 0.261 | 403 | 0.072 | 0.310 | 0.60 |

## Table 7.6.3. Percentage of Underpriced issues in the Cold/Hot market

The cold market is identified as the period lasting from the first quarter of 1988 to the first quarter of 1991, in which the average number of IPOs coming to the market per month is less than 20. The hot market is identified as the period from the second quarter of 1991 to the end of 1993. This table reports the percentages of issues that are underpriced in the cold/hot market respectively. The last column reports p-values from t-tests comparing percentages of underpriced issues occurring in the cold market and hot market. In the first row, underpricing is determined as whether UFM is greater than zero or not. In the second row, underpricing is determined as whether UTF is greater than zero or not. In the last row, underpricing is determined as whether UTM is greater than zero or not. Here F is the final filing price, T is the first trading day closing price and M is the mean initial filing price. UFM, UTF and UTM have been adjusted for market movement.

| | Cold Market | | Hot Market | | |
|---|---|---|---|---|---|
| | N | Percent of Underpriced Issues | N | Percent of Underpriced Issues | p-value |
| UFM | 128 | 41% | 403 | 38% | 0.53 |
| UTF | 128 | 82% | 403 | 71% | 0.02 |
| UTM | 128 | 52% | 403 | 63% | 0.03 |

**Table 7.6.4. Regression results for models 7.9 to 7.11**

This table presents regression results for models 7.9 to 7.11. MUTF, MUFM, and MUTM are mean UTF, UFM and UTM respectively in each quarter from 1988 to 1993. Here, $UTF$= (T-F)/F, UFM=(F-M)/M, UTM=(T-M)/M, and T is the first trading day closing price, F is the final filing price and M is the mean filing price. S is the number of IPOs in each quarter. UTF, UFM and UTM have been adjusted for the market movement.

| | $\alpha_i$ | $\beta_i$ | $R^2$ | F-statistic | Significance of F |
|---|---|---|---|---|---|
| | | | $MUTF = \alpha_1 + \beta_1 * S$ | | |
| Estimate of Coefficient | 0.1019 | 0.0001 | 0.01% | 0.001 | 0.9701 |
| Standard Error | 0.015 | 0.001 | | | |
| | | | $MUFM = \alpha_2 + \beta_2 * S$ | | |
| Estimate of Coefficient | -0.0137 | -0.0006 | 1.8% | 0.396 | 0.5357 |
| Standard Error | 0.027 | 0.001 | | | |
| | | | $MUTM = \alpha_3 + \beta_3 * S$ | | |
| Estimate of Coefficient | 0.0894 | -0.0004 | 0.39% | 0.086 | 0.7722 |
| Standard Error | 0.039 | 0.001 | | | |

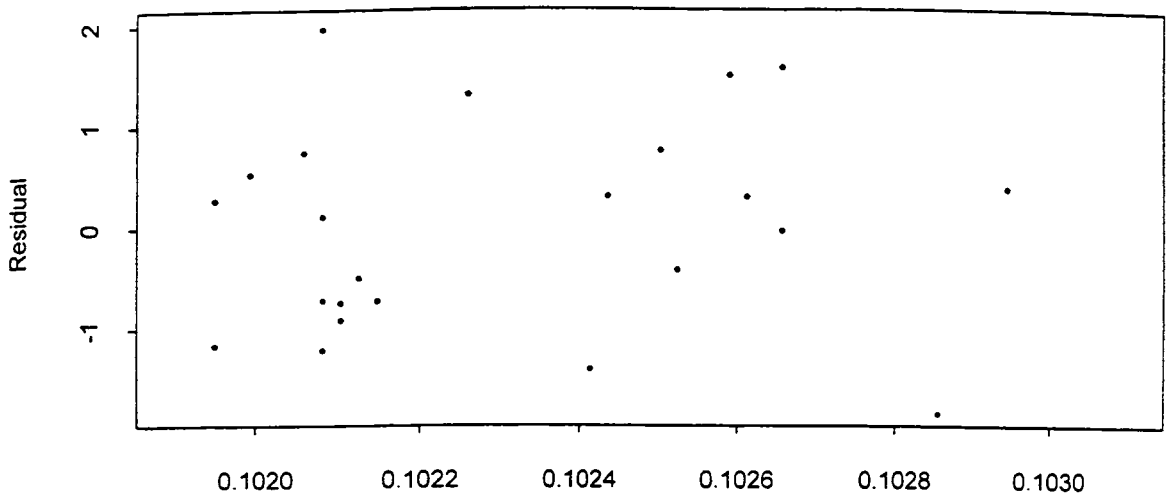


Figure 7.6.1. Fitted Values of MUTF

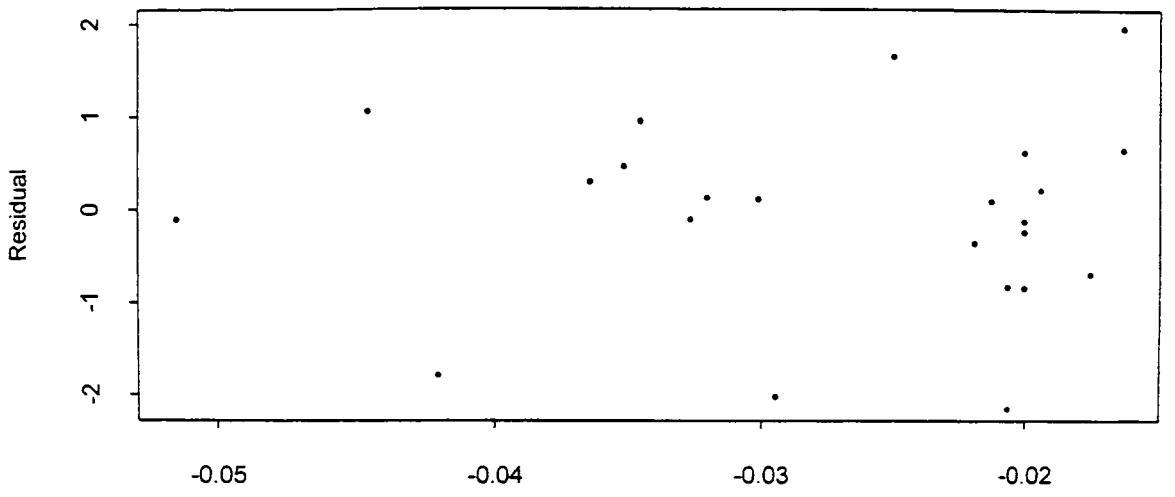


Figure 7.6.2. Fitted Values of MUFM

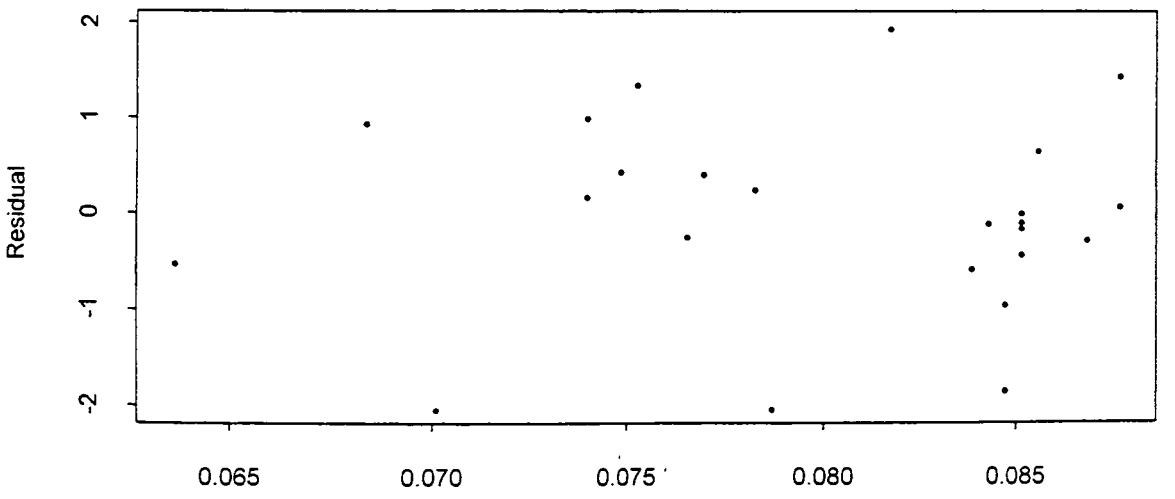


Figure 7.6.3. Fitted Values of MUTM

### 7.6.2. Impact of Interest Rate on the Forming of Hot/Cold Market

This section examines how risk free interest rate affects the status of hot and cold market. As discussed in 4.3.1, hot market is regarded as the market condition where abnormally large number of IPO issue volumes occurs. While in cold market, IPO volumes are very low. The observations of the number of issues in the sample support such a proposition. It is evident that the cycle of hot and cold market does repeat itself. In certain years, the number of IPOs is obviously larger than that in other years.

Table 7.6.5 shows the number of IPOs issued in each calendar quarter from 1988 through 1993 and average interest rate prevailing at the time in each quarter. From this table, one can see that the cold market continued from the first quarter of 1988 to the first quarter of 1991. The hot market started to emerge in the second quarter of 1991 and continued to the end of time period over which my data was collected.

Table 7.6.5 clearly demonstrates that the number of IPOs linearly declines as the interest rate rises. From Table 7.6.5, it is obvious that the interest rate in the cold market is significantly higher than that in the hot market. The average interest rate in the cold market, $Int_c$, is equal to 7.30 percent with standard error, $s_c$, equivalent to 0.08%. The average interest rate in the hot market, $Int_h$, is equal to 3.74 percent with standard error, $s_h$, equivalent to 0.05%.

A two sample t-test comparing interest rate accompanying each of the cold and hot market can be calculated as

$$t = \frac{Int_c - Int_h}{\sqrt{s_c^2 + s_h^2}}.$$

The t-statistic is 38.99. The p-value is less than 0.0001, therefore, the difference in interest rates between the cold and hot market is strongly significant.

Since the number of IPOs in each quarter is a positive integer, it can be considered as a Poisson variable. Let $y_i$ be the number of IPOs in quarter $i$, then

the density of $y_i$, $f(y_i, \mu_i)$. has the following form:

$$f(y_i, \mu_i) = \frac{\exp(-\mu_i)\mu_i^{y_i}}{y_i!},$$

where $\mu_i$ is the expected number of IPOs in quarter $i$. To relate the number of IPOs with risk free interest rate while taking into account the time effect, we consider the Poisson regression with the following link function:

$$\log(\mu_i) = \beta_0 + \beta_1 I_i + \beta_2 S, \tag{7.12}$$

where $I_i$=the $i$th quarter average interest rate, $S$ is a variable used to represent the number of quarters from the first quarter of 1988 to the last quarter of 1993. For instance, $S$=0 stands for the first quarter of 1988, $S$=23 for the forth quarter of 1993. and $\beta_0, \beta_1, \beta_2$ are model parameters. Maximum likelihood estimates of model parameters were obtained by using standard Poisson general linear model method.

One can see from Table 7.6.6 that after adjusting time effect, risk free interest rate is inversely related to the number of IPOs coming to the market significantly.

**Table 7.6.5. Number of offerings issued in each quarter and average interest rate**

This table reports number of IPOs issued in each calendar quarter from 1988 to 1993. and average interest rates at the time when offerings were issued.

| Year | Quarter | Number of IPOs | Mean Interest Rate |
|---|---|---|---|
| | 1 | 10 | 5.71% |
| 1988 | 2 | 11 | 6.29% |
| | 3 | 10 | 6.81% |
| | 4 | 11 | 7.72% |
| | 1 | 6 | 8.58% |
| 1989 | 2 | 13 | 8.29% |
| | 3 | 4 | 7.82% |
| | 4 | 12 | 7.66% |
| | 1 | 9 | 7.83% |
| 1990 | 2 | 18 | 7.75% |
| | 3 | 10 | 7.54% |
| | 4 | 4 | 6.74% |
| | 1 | 10 | 5.98% |
| 1991 | 2 | 30 | 5.67% |
| | 3 | 26 | 5.54% |
| | 4 | 33 | 4.55% |
| | 1 | 49 | 4.04% |
| 1992 | 2 | 45 | 3.68% |
| | 3 | 25 | 3.37% |
| | 4 | 29 | 3.11% |
| | 1 | 34 | 2.96% |
| 1993 | 2 | 36 | 3.01% |
| | 3 | 36 | 3.01% |
| | 4 | 60 | 3.09% |

**Table 7.6.6 Poisson Regression Results for Model 7.12**
This table presents parameter estimates of the model. $\log(\mu_i) = \beta_0 + \beta_1 I_i + \beta_2 S$, where $\mu_i$ is the expected number of IPOs in the $i$th quarter: $I_i$ is the interest rate in quarter $i$; and $S$ is number of quarters since the first quarter in 1988. The column of estimate gives the estimates of each regression parameter and the last column gives their respective standard error estimate. The third column is calculated as the respected estimates divided by its standard error. The forth column reports the corresponding $p$-values.

| Parameter | Estimate | T for $H_0$: Parameter=0 | Pr > \|T\| | Std Error of Estimate |
|---|---|---|---|---|
| $\beta_0$ | 3.305 | 6.843 | 0.0001 | 0.483 |
| $\beta_1$ | -0.163 | -3.051 | 0.0020 | 0.053 |
| $\beta_2$ | 0.043 | 2.856 | 0.0040 | 0.015 |

## 7.7 Interrelationship Among Explanatory Variables

In this section, I will examine the interrelationship among the explanatory variables such as interest rate, hot/cold market index, total proceed, time and type of industry. As discussed in the previous section, the hot and cold market are defined by the number of IPOs issued in each quarter. The average number of IPOs issued in a hot market is considerably higher than in a cold market. Table 7.7.1 shows the average interest rate and average total proceeds in millions US dollars by hot and cold market. One can see that the average total proceeds in the hot and cold market are almost the same. A t-test to test the null hypothesis that the average total proceeds are the same in the hot and cold market has a p-value of 0.91, which indicates that the average total proceeds do not differ whether or not there are many IPOs or few IPOs. From the same table, one can see that the average interest rate was much higher in the cold market than in the hot market. A t-test to test the null hypothesis that the average interest rate are the same in the hot and cold market has a p-value less than 0.0001, which indicates that the interest rates in the cold and hot market do differ.

Table 7.7.2 shows the average interest rate and total proceeds corresponding to IPOs of different types of industry. The F-test to test the null hypothesis that

the total proceeds corresponding to different industries' IPOs are the same has a p-value of 0.001. One can also observe from Table 7.7.2 that on the average, IPOs from the banking industry has the highest total proceeds followed by the heavy industry. IPOs from the light and High-tech industries have the lowest total proceeds. Interest rates accompanying different industries' IPOs seem to be the same.

Table 7.7.3 shows the correlation matrix of demand index (UFM), interest rate, total proceeds, and time. Here, let time equal to 1 for the 1st quarter of 1988, time equal to 2 for the 2nd quarter of 1988, and so on. Time equals to 24 for the 4th quarter of 1993. One can see that the interest rate has a negative correlation with time between 1988 and 1993 meaning the interest rate were declining during this period of time. The correlation between interest rate and total proceeds is weak.

**Table 7.7.1. Summary of Interest Rates and Total Proceeds by Hot/Cold Market Conditions**

Market condition is defined based on the number of IPOs issued in each quarter. In this data set, the cold market lasted from the first quarter of 1988 until the first quarter of 1991. The hot market started from the second quarter of 1991 until the end of 1993, which is the last time period collected in this data set. Here, Intx =Interest Rate and Pro=Total Proceeds. Total proceeds are in million US dollars.

| | Cold Market | | | Hot Market | | |
|---|---|---|---|---|---|---|
| | N | Mean | S.D. | N | Mean | S.D. |
| Intx | 128 | 7.30% | 0.87% | 403 | 3.74% | 0.91% |
| Pro | 128 | 37.04 | 93.67 | 403 | 51.51 | 219.2 |

**Table 7.7.2. Summary of 531 IPOs by Industry**

This table summarizes interest rates and total proceeds statistics by industry. Light industry includes apparel, appliances, cosmetic, fabric, farm product, food, jewelry, leather, multiple, office equipment, paper, plastic product, publishing, sporting goods, toys, wine, and wood product; Heavy industry includes aircraft, automotive, chemical, industrial machinery, metal product, power supplies, ships & homes, and steel; High-tech industry includes computers, electronic components, family electronics, medical instruments, pharmaceutical, photo product, R & D, scientific instruments, semiconductors and telecommunications equipment; and Banking industry includes commercial banks. Interest rate is the average interest rate when corresponding issues were offered. Total proceed is in million US dollars.. Corresponding standard deviations are reported in parenthesis. N in column two is the number of issues.

| Type of Industry | N | Interest Rate (S.D.) | Total Proceeds (S.D.) |
|---|---|---|---|
| Light Industry | 123 | 4.55% (1.79%) | 49.00 (81.53) |
| Heavy Industry | 70 | 4.58% (1.95%) | 65.73 (115.8) |
| High-Tech Industry | 319 | 4.64% (1.73%) | 41.79 (237.15) |
| Banking Industry | 19 | 4.13% (1.74%) | 80.99 (207.45) |
| F-value | | 0.54 | 0.47 |
| p-value | | 0.66 | 0.70 |

**Table 7.7.3. Correlation Matrix of Explanatory Variables**

This table presents a correlation matrix among demand (UFM), interest rate (INTX), total proceed (PRO) and time, where time equal to 1 for the 1st quarter of 1988, time equal to 2 for the 2nd quarter of 1988, and so on. Time equals to 24 for the 4th quarter of 1993.

Correlation Matrix

| | UFM | INTX | PRO | TIME |
|---|---|---|---|---|
| UFM | 1.0000 | 0.0630 | -0.0410 | -0.0170 |
| INTX | | 1.0000 | -0.0264 | -0.8889 |
| PRO | | | 1.0000 | 0.0222 |
| TIME | | | | 1.0000 |

## 7.8 Results on Cross-Sectional Analysis

To obtain insights into the relationships between IPOs' initial performance and risk free interest rate, market demand, total proceeds, hot/cold market index, different industries as well as their interactions, let's first consider the relationship between initial return, UTF, and demand (UFM) along with other explanatory variables. The null hypothesis is that the initial return (UTF) is unrelated to the above mentioned explanatory variables. The alternative is that these explanatory variables do affect the initial returns of a IPO. The following model attempts to establish a linear relationship between UTF and UFM, interest rate, total proceeds, hot/cold market index and different type of industries.

$$\begin{aligned} UTF &= \beta_0 + \beta_1 UFM + \beta_2 INX + \beta_3(1/P) + \beta_4 UFM * INX \\ &\quad + \beta_5 UFM * (1/P) + \beta_6(HCMI) + \tilde{\beta}_7' INY + \varepsilon \end{aligned} \tag{7.13}$$

where $UTF = (T - F)/F$, and $UFM = (F - M)/M$, where T is the first trading day closing price; F is the offer price and M is the mean of initial filing price; $\beta_i$ are the regression coefficients for equations 7.13; INX is the interest rate at the time of IPO issuing; P is the total proceeds of a particular IPO; HCMI is the hot/cold market index, where HCMI=0, when there is a hot market, HCMI=1 otherwise. Furthermore, for the Light Industry, $INY'$=(0,0,0), for the Heavy Industry, $INY'$=(1,0,0), for the High-Tech Industry, $INY'$=(0,1,0), and for the Banking Industry, $INY'$=(0,0,1). Here, $\tilde{\beta}_7$ is a 3×1 vector and the $\varepsilon$ is the random disturbance. These regression models make it possible to examine the interdependencies between the factors that affect IPOs' initial performances in the cross-sectional model. Table 7.8.1 presents the parameter estimates and their standard errors. One can see from the p-value column that different types of industries do not seem to affect the underpricings of IPO. The relationship between underpricing and demand, total proceeds and so on remains the same across all industries. The p-value associated with the hot/cold market index is

0.6508 followed by the reciprocal of total proceed with a p-value of 0.4911. The p-value associated with risk free interest rate is 0.4309.

**Table 7.8.1. Results from Regression Analysis of Model (7.13)**

This table present results from the linear regression procedure. Model 7.13 has the form: $UTF = \beta_0+\beta_1 UFM+\beta_2 INX+\beta_3(1/P)+\beta_4 UFM* INX + \beta_5 UFM*(1/P) + \beta_6(HCMI) + \tilde{\beta}_7' INY$, where T is the first trading day closing price; F is the offer price and M is the mean of initial filing price; INX is the interest rate at the time of IPO issuing; P is the total proceeds of a particular IPO; HCMI is the hot/cold market index, where HCMI=0, when there is a cold market, HCMI=1 otherwise. Furthermore, $\tilde{\beta}_7' = (\beta_{71}, \beta_{72}, \beta_{73})$; for the Light Industry, INY'=(0,0,0), for the Heavy Industry, INY'=(1,0,0), for the High-Tech Industry, INY'=(0,1,0), and for the Banking Industry, INY'=(0,0,1). Here, $\tilde{\beta}_7$ is a $3 \times 1$ vector. UTF, UFM and UTM have been adjusted for the market movement.

| Variable | Estimate | Standard Error | t-statistic | p-value |
|---|---|---|---|---|
| $\beta_0$ | 0.1431 | 0.0600 | 2.382 | 0.0176 |
| $\beta_1$ | 0.5803 | 0.1160 | 5.001 | 0.0001 |
| $\beta_2$ | -0.0060 | 0.0076 | -0.788 | 0.4309 |
| $\beta_3$ | 0.0606 | 0.0880 | 0.689 | 0.4911 |
| $\beta_4$ | -0.0221 | 0.0241 | -0.917 | 0.3598 |
| $\beta_5$ | -1.2034 | 0.5189 | -2.319 | 0.0208 |
| $\beta_6$ | -0.0144 | 0.0318 | -0.453 | 0.6508 |
| $\beta_71$ | -0.0247 | 0.0237 | -1.042 | 0.2981 |
| $\beta_72$ | 0.0190 | 0.0167 | 1.139 | 0.2554 |
| $\beta_73$ | -0.0353 | 0.0389 | -0.909 | 0.3638 |

To eliminate the insignificant factors in model (7.13), we applied the back-elimination procedure in which one factor was eliminated at a time until only significant factors remain in the model. After the back-elimination procedure, the intercept term, demand index (UFM), reciprocal of the total proceeds(1/P) and interaction between UFM and (1/P) remained in the model. The revised model has the following form:

$$UTF = b_0 + b_1 UFM + b_2(1/P) + b_3 UFM*(1/P) + \varepsilon. \qquad (7.14)$$

Upon examining the residual plots from the regression analysis for the above model, it is clear that the residuals exhibited severe nonrandom behavior. The R-square was about 16%. The reciprocal transformation of (1+UTF) was chosen and it leads to the following model.

$$\frac{1}{1+UTF} = b_0 + b_1 UFM + b_2(1/P) + b_3 UFM * (1/P) + \varepsilon. \qquad (7.15)$$

Figures 7.8.1 to 7.8.3 showed figures which plot the residuals from model 7.15 against the predicted value of the response variable (1/(1+UTF))as well as the two explanatory variables in the regression analysis. The residual plots are basically satisfactory although there is evidence of heteroscedasticity. There are no suggestions in the diagnostic plots that nonlinearity existed in the data. To correct for the effect of the heteroscedasticity on the variance estimates of the regression parameters, a corrected consistent covariance of regression parameter was computed. The R-square for this model is 18%. Table 7.8.2 presents the results of the collinearity diagnostics of the model (7.15).

**Table 7.8.2. Collinearity Diagnostics of Model 7.15**
The condition indices are the square roots of the ratio of the largest eigenvalue to each individual eigenvalue. Columns 4 to 7 report the proportion of the variance of the estimate accounted for by each principle component.

| | | Condition | Variance Proportion | | | |
|---|---|---|---|---|---|---|
| Number | Eigenvalue | Index | $b_0$ | UFM | 1/P | UFM*(1/P) |
| 1 | 1.9880 | 1.0000 | 0.0682 | 0.0669 | 0.0606 | 0.0589 |
| 2 | 1.4118 | 1.1867 | 0.0706 | 0.0885 | 0.0914 | 0.1104 |
| 3 | 0.3172 | 2.5037 | 0.0049 | 0.8445 | 0.0000 | 0.8240 |
| 4 | 0.2831 | 2.6500 | 0.8564 | 0.0001 | 0.8480 | 0.0067 |

The largest condition index is the condition number of the scaled regression matrix. When this number is large, the data are said to be ill-conditioned. When this number is extremely large, the estimates may have a fair amount of numerical error. Usually, a condition index greater than 10.0 is considered large. The largest condition number from model (7.15) is 2.64 which indicates that this data set is

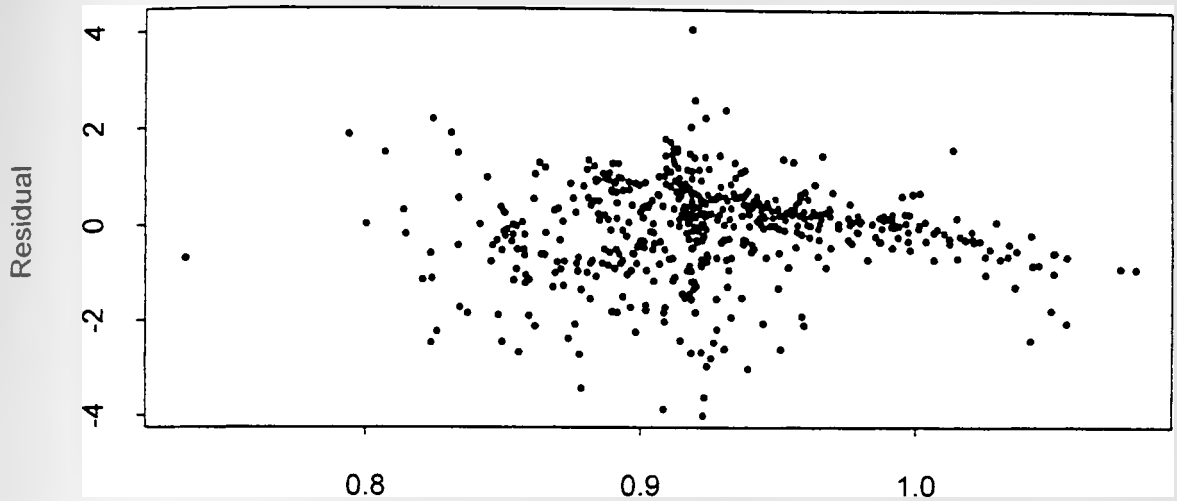


Figure 7.8.1. Fitted Values of 1/(1+UTF)

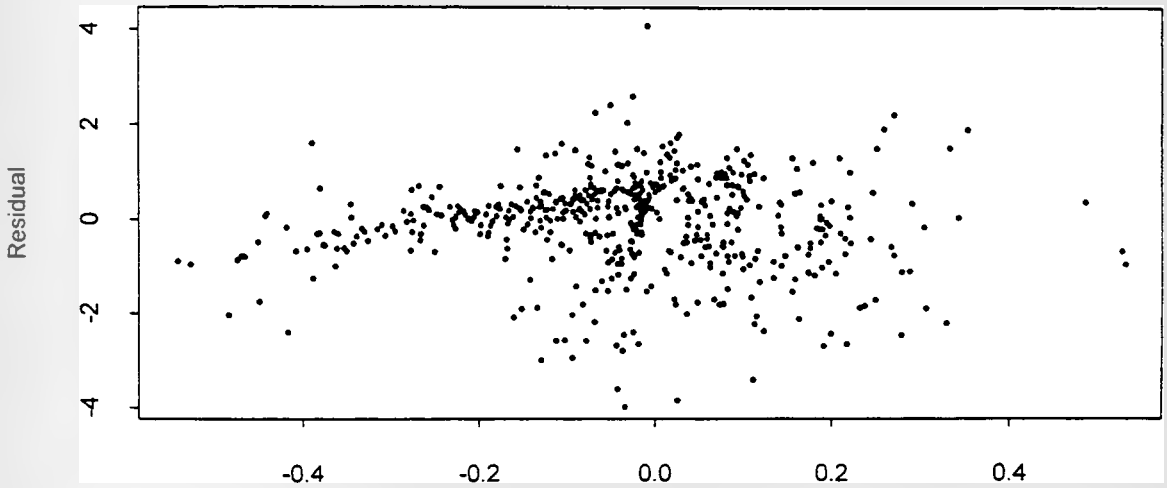


Figure 7.8.2. UFM

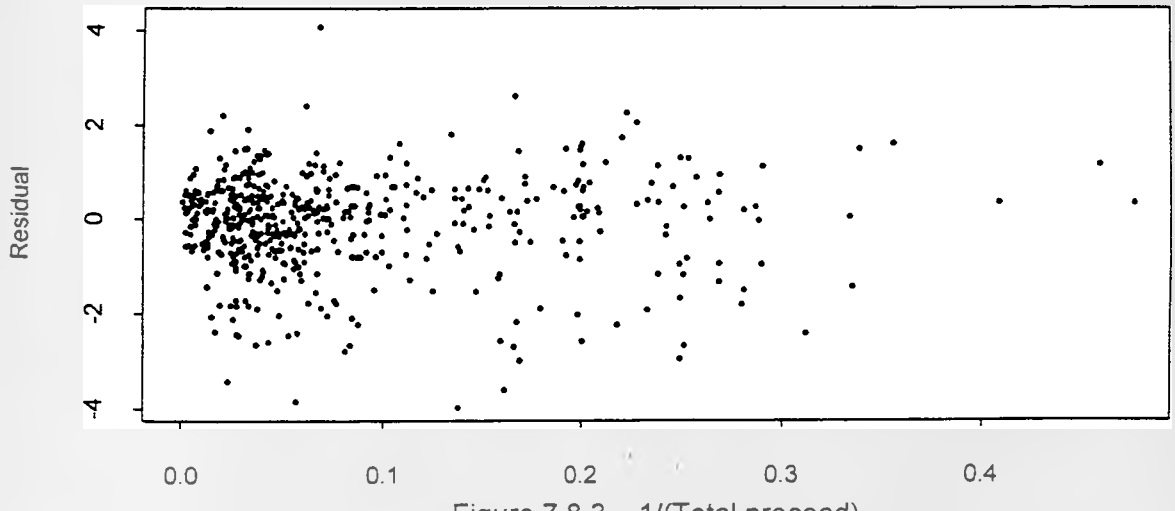


Figure 7.8.3. 1/(Total proceed)

not ill-conditioned. Columns 4, 5, 6, and 7 report the proportions of the variance of the estimate accounted for by each principle component. A variance inflation factor was calculated for each estimate. These factors measure the inflation in the variances of the parameter estimates due to collinearities that exist among the regressor variables. The variance inflation factors for UFM, 1/P and UFM*(1/P) are respectively 1.82, 1.00 and 1.82. These numbers are not large enough to affect the predicted values of the model. Nevertheless, the consistent covariance of estimates which take into account any collinearities exist in the model will be used in the statistical inference.

Table 7.8.3 reports the results from regression analysis of model 7.15. The F-value of 39.52 with degrees of freedom (3, 530) has a p-value equivalent to 0.0001. This suggests that there is a significant linear relationship between initial return and the dependent variables, namely, UFM, reciprocal of total proceeds (1/P) and the interaction between UFM and (1/P). Therefore, we can reject the null hypothesis that there is no relationship existed between initial return UTF and any of the explanatory variables UFM, interest rate, total proceeds, hot/cold market index and type of industries. The standard errors of the regression coefficients shown in Table 7.8.3 have been corrected for the heteroscedasticity which exists in the model. We can see that UFM has a regression coefficient equivalent to -0.359 with an estimated standard error equal to 0.038, indicating the positive association between UFM and initial performance, UTF, is strongly significant.

The interaction term (UFM*(1/P)) is significant with coefficient equivalent to 1.004. It suggests that the relationship between underpricing, UTF and demand index, UFM changes across different initial public offerings with different amount of total proceeds. The increase in underpricing (UTF) corresponding to the increase in demand (UFM) depends on the total proceeds of the IPO. In general, given a fixed total proceeds, the underpricing increases as demand (UFM) increases, and given a fixed demand, the underpricing increases as the

total proceeds increase.

**Table 7.8.3 Regression results for model (7.15)**
UTF is calculated as (T-F)/F and UFM is calculated as (F-M)/M; T is the first trading day closing price; F is the final filing price and M is the mean filing price. INX is the risk free interest rate at the time when IPOs were issued; P is the total proceeds of the offerings. Model 7.15 has the following form.
$1/(1+UTF) = b_0 + b_1 UFM + b_2(1/P) + b_3 UFM * (1/P)$.
The F-value in the last row measures the overall significance of the above model. UTF, UFM and UTM have been adjusted for the market movement.

| Variables | Estimate | Standard Error | t-test statistic | p-value |
|---|---|---|---|---|
| Constant | 0.915 | 0.007 | 136.08 | 0.0001 |
| UFM | -0.359 | 0.038 | -9.405 | 0.0001 |
| 1/P | -0.010 | 0.059 | -0.163 | 0.8702 |
| UFM*(1/P) | 1.004 | 0.344 | 2.918 | 0.0037 |
| $R^2$ | 18% | | | |
| F-value | 36.51 | | | 0.0001 |

We now consider the relationship between UFM and interest rate, total proceeds, hot/cold market indicator and different types of industries. Here, UFM can be viewed as the first stage underpricing. The null hypothesis is that risk free interest rate, total proceed, hot/cold market condition, and type of industries do not affect how a firm determine their final offering price. The alternative is that the above mentioned explanatory variables do affect the determination of the final offering price. To test this hypothesis, let's consider the following model.

$$UFM = \beta_0 + \beta_1 INX + \beta_2 P + \beta_3(HCMI) + \tilde{\beta}_4' INY + \varepsilon \qquad (7.16)$$

where $UFM = (F - M)/M$, where F is the offer price and M is the mean of initial filing price; $\beta_i$ are regression coefficients for equations 7.16; INX is the interest rate at the time of IPO issuing; P is the total proceeds of a particular IPO; HCMI is the hot/cold market index, where HCMI=0, when there is a cold market, HCMI=1 otherwise. Furthermore, for the Light Industry, $INY'$=(0,0,0), for the Heavy Industry, $INY'$=(1,0,0), for the High-Tech Industry, $INY'$=(0,1,0),

and for the Banking Industry, $INY'$=(0,0,1). Here, $\tilde{\beta}_4$ is a 3×1 vector and the $\varepsilon$'s are the random disturbances.

Figures 7.8.4 to 7.8.6 showed figures which plot the residuals from model 7.16 against the predicted value of initial return (UFM) as well as the two explanatory variables in the regression analysis, interest rate and the reciprocal of the total proceeds. The residual plots are basically satisfactory although there is evidence of heteroscedasticity. There are no suggestions in the diagnostic plots that non-linearity existed in the data. To correct for the effect of the heteroscedasticity on the variance estimates of the regression parameters, a corrected consistent covariance of regression parameter was computed. The R-square for this model is 1.4%. The p-value of the F-test for significance of model (7.16) is 0.30, which indicates that the interest rate, hot/cold market condition, type of industry do not linearly affect UFM. Transformations of UFM did not improve the fit of the model. Collinearity diagnosis of model 7.16 reveals collinearity among the regressors. The collinearity is mainly caused by the correlation between interest rates and the reciprocal of the total proceed. The correlation between interest rate and the reciprocal of the total proceed is about 14.5 percent. Once either interest rate or total proceed is removed from the model, the collinearity disappeared. However, the fit of the model did not improve. Table 7.8.4 presents the regression results for model 7.16.

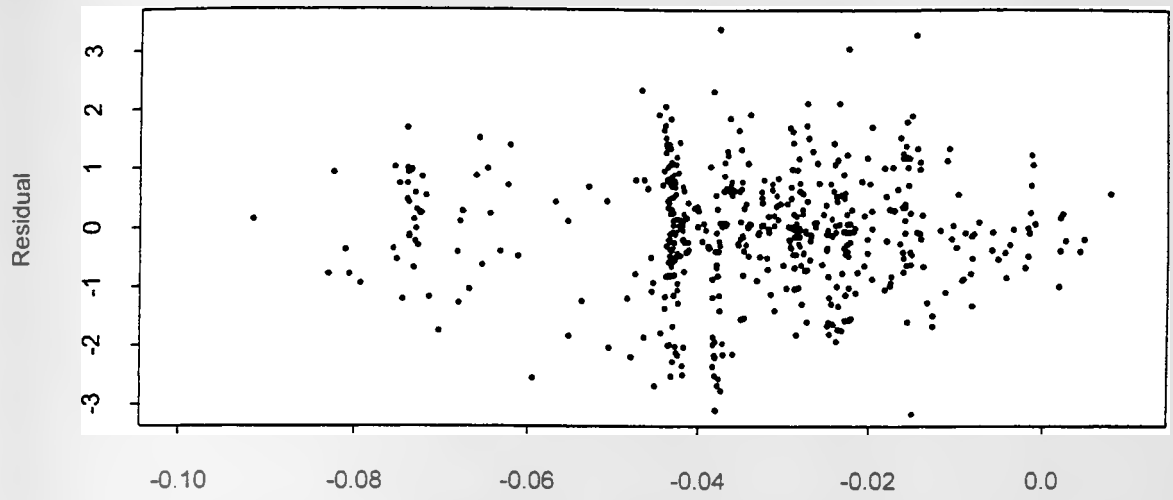


Figure 7.8.4. Fitted Values of UFM

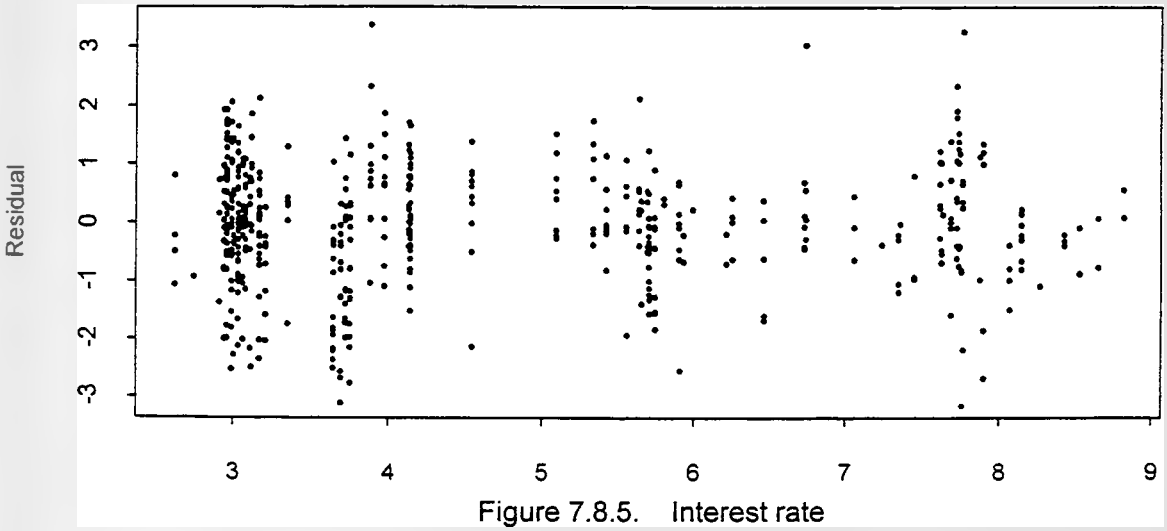


Figure 7.8.5. Interest rate

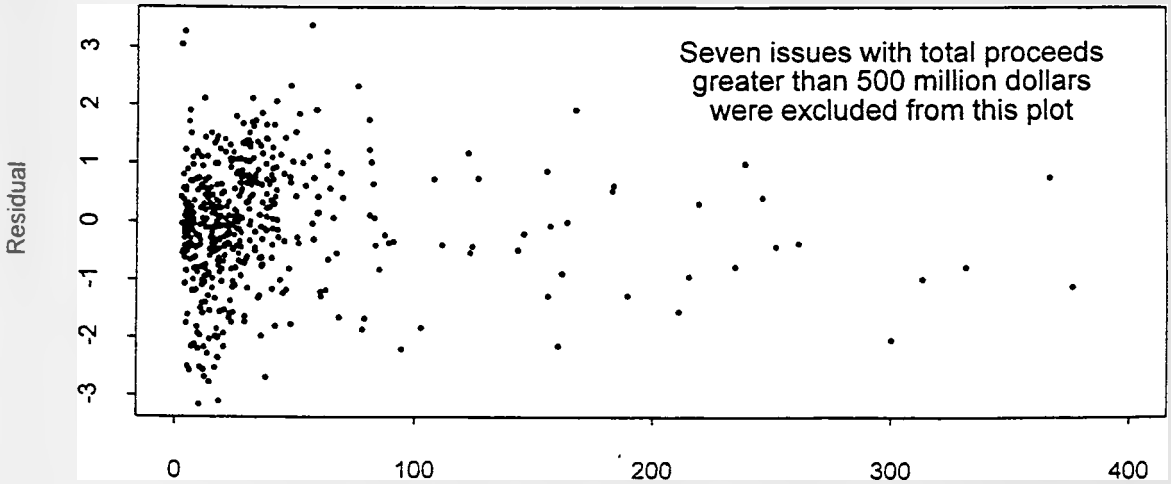


Figure 7.8.6. Total proceeds

**Table 7.8.4 Regression results for model (7.16)**

UFM is calculated as (F-M)/M; F is the final filing price and M is the mean filing price. INX is the risk free interest rate at the time when IPOs were issued; P is the total proceeds of the offerings. Model 7.16 has the following form. $UFM = b_0 + b_1 INX + b_2(1/P) + b_3 HCMI + b_4' INY$, where INX is the interest rate; P is the total proceeds; HCMI=0, when it was a cold market and HCMI=1 otherwise; INY is a 3 by 1 vector, INY'=(0,0,0) for the light industry, INY'=(1,0,0) for the heavy industry, INY'=(0,1,0) for the high-tech industry, and INY'=(0,0,1) for the banking industry. The F-value in the last row measures the overall significance of the above model. UTF, UFM and UTM have been adjusted for the market movement.

| Variables | Estimate | Standard Error | t-test statistic | p-value |
|---|---|---|---|---|
| Constant | -0.0592 | 0.0618 | -0.958 | 0.3383 |
| INTX | 0.0076 | 0.0080 | 0.946 | 0.3446 |
| P | -0.0000 | 0.0000 | -0.870 | 0.3850 |
| HCMI | 0.0083 | 0.0332 | 0.249 | 0.8031 |
| $INY_1$ | -0.0446 | 0.0248 | -1.803 | 0.0720 |
| $INY_2$ | -0.0144 | 0.0175 | -0.823 | 0.4111 |
| $INY_3$ | -0.0038 | 0.0408 | -0.094 | 0.9253 |
| $R^2$ | 1.2% | | | |
| F-value | 1.068 | | | 0.3805 |

We now consider the relationship between UTM and interest rate, total proceeds, hot/cold market indicator and different types of industry.

$$UTM = \beta_0 + \beta_1 INX + \beta_2 P + \beta_3(HCMI) + \tilde{\beta}_4' INY + \varepsilon \qquad (7.17)$$

where $UFM = (F - M)/M$, where F is the offer price and M is the mean of initial filing price; $\beta_i$ are the regression coefficients for equations 7.17, INX is the interest rate at the time of IPO issuing; P is the total proceeds of a particular IPO; HCMI is the hot/cold market index, where HCMI=0, when there is a cold market, HCMI=1 otherwise. Furthermore, for the Light Industry, $INY'$=(0,0,0), for the Heavy Industry, $INY'$=(1,0,0), for the High-Tech Industry, $INY'$=(0,1,0), and for the Banking Industry, $INY'$=(0,0,1). Here, $\tilde{\beta}_4$ is a 3×1 vector and the $\varepsilon$'s are the random disturbances.

Figures 7.8.7 to 7.8.9 showed figures which plot the residuals from model 7.17

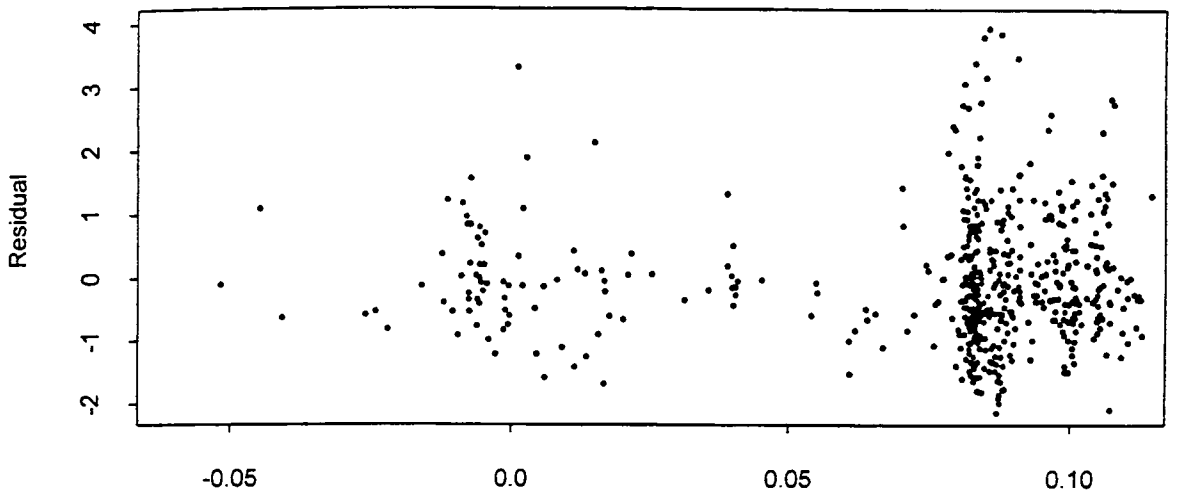


Figure 7.8.7. Fitted Values of UTM

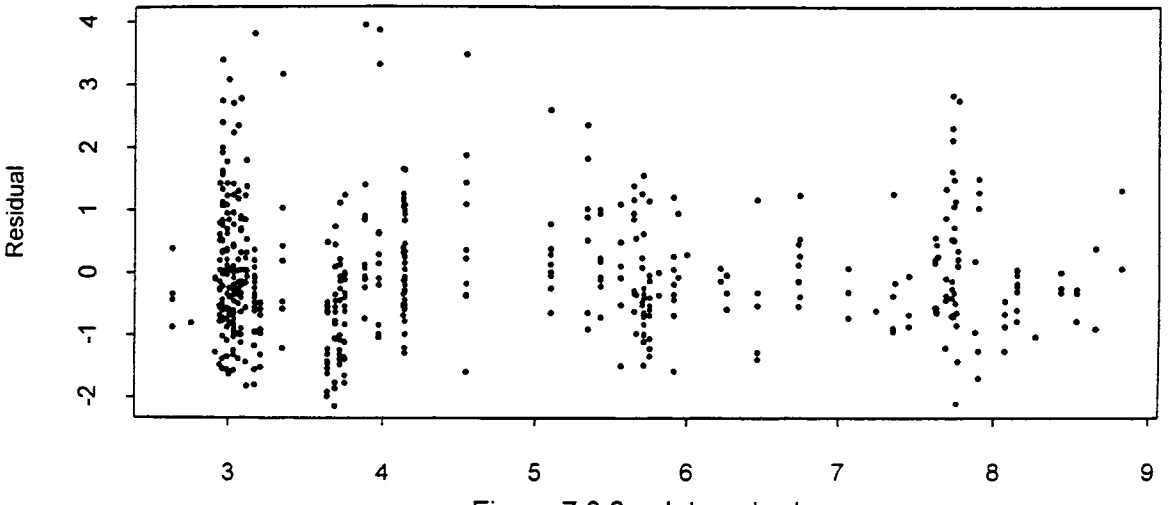


Figure 7.8.8. Interest rate

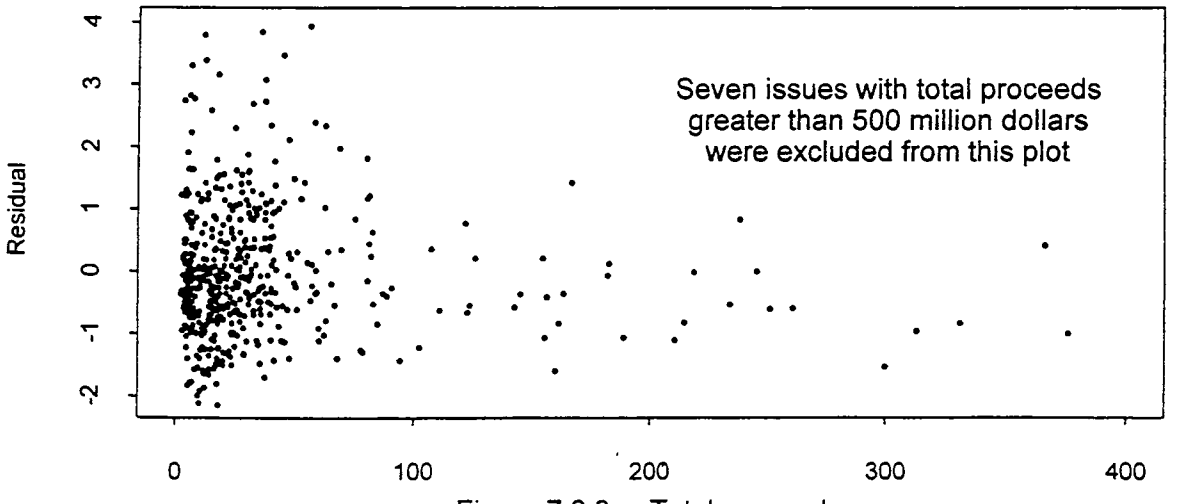


Figure 7.8.9. Total proceeds

against the predicted value of UTM as well as the two explanatory variables in the regression analysis, interest rate and the reciprocal of the total proceeds. The residual plots are basically satisfactory although there is evidence of heteroscedasticity. There are no suggestions in the diagnostic plots that nonlinearity existed in the data. To correct for the effect of the heteroscedasticity on the variance estimates of the regression parameters, a corrected consistent covariance of regression parameter was computed. The R-square for this model is 1.5%. The p-value of the F-test for significance of model (7.17) is 0.24, which indicates that the interest rate, hot/cold market condition, type of industry do not linearly affect UTM. Table 7.8.5 presents the regression results for model 7.17.

In summary, this section first established a relationship between initial return (UTF) and demand index (UFM) and total proceed. It was found that UTF is significantly related to UFM positively. However, the effect of UFM changes as the total proceed changes. Viewed as the first stage underpricing, UFM was modeled as a dependent variable in a linear model with interest rate, total proceed, hot/cold market index and type of industries as explanatory variables. But the model is not statistically significant.

**Table 7.8.5. Regression results for model (7.17)**

UTM is calculated as (T-M)/M; T is the first day closing price and M is the mean filing price. INX is the risk free interest rate at the time when IPOs were issued; P is the total proceeds of the offerings. Model 7.17 has the following form.

$UTM = b_0 + b_1 INTX + b_2(1/P) + b_3 HCMI + b_4' INY,$

where INIX is the interest rate; P is the total proceeds; HCMI=0, when it was a cold market and HCMI=1 otherwise; INY is a 3 by 1 vector, INY'=(0,0,0) for the light industry, INY'=(1,0,0) for the heavy industry, INY'=(0,1,0) for the high-tech industry, and INY'=(0,0,1) for the banking industry. The F-value in the last row measures the overall significance of the above model. UTF, UFM and UTM have been adjusted for the market movement.

| Variables | Estimate | Standard Error | t-test statistic | p-value |
|---|---|---|---|---|
| Constant | 0.0576 | 0.1117 | 0.516 | 0.6064 |
| INTX | 0.0065 | 0.0145 | 0.446 | 0.6560 |
| P | -0.0001 | 0.0001 | -1.232 | 0.2185 |
| HCMI | 0.0070 | 0.0599 | 0.117 | 0.9065 |
| $INY_1$ | -0.0889 | 0.0448 | -1.987 | 0.0475 |
| $INY_2$ | -0.0001 | 0.0317 | -0.001 | 0.9990 |
| $INY_3$ | -0.0434 | 0.0737 | -0.589 | 0.5563 |
| $R^2$ | 1.5% | | | |
| F-value | 1.329 | | | 0.2422 |

## 7.9 Summary

In this chapter, we have conducted an empirical study to test the relationship between underpricing and various market variables including interest rate prevailing at the time of stock offering, demand index, total proceeds, and hot/cold market conditions. Here, the demand index is defined as the distance from the final offering price to the mean of the initial high and low filing price and we say that a hot market occurs when the total number of stock offering is more than about twenty and a cold market occurs otherwise.

The interest rates accompanying underpriced issues are significantly higher than those accompanying overpriced ones although the difference between the first day closing price and the final offering price is not linearly related to the interest rates. The interest rate influences that underpricing in an nonlinear fashion. This also explains why the interest rates is not a significant factor in the

multivariate analysis.

The demand index is highly correlated with underpricing. The probability of drawing a winning issue is significantly higher when the demand index is positive than when the demand index is negative or zero. The underpricing is an increasing function of the demand index as well. This empirical study shows that the demand index is a proxy of the true market demand. This empirical study also shows that the underpricing is inversely proportional to the total proceeds as suggested by equation (6.7) in Chapter 6.

Although there is no evidence that the underpricing is influenced by the hot/cold market condition, interest rate does have an impact in the forming of hot/cold market. Our data suggest that more issues are offered when the interest rate is low than when the interest rate is high. The multivariate analysis found a significant relationship between underpricing and the demand index, total proceeds and the interaction between the total proceeds and demand index. This multivariate model provides a tool to access the overall effect of the demand index and total proceeds on the underpricing of IPOs.

# Chapter Eight

# Conclusions

## 8.1. Institutional Framework: A Major Attribute to Underpricing

The results of the empirical study fortifies the author's theoretical argument that IPO underpricing is not merely a subjective decision of the issuing firm but rather a reflection of the prevailing market condition and overall financial environment. Underpricing as a universal phenomenon is affected by the institutional framework as well as the concurrent investment environment when IPOs are issued.

(1) IPO process is strictly regulated by the institutional framework, thus IPO price determination is affected by such institutional procedures.

(2) Pricing and payment methods required by regulations, although different in the United States and United Kingdom, put constraints on investors' investment behaviors which in turn influence IPO pricing.

## 8.2. Underpricing Investigated from a New Perspective: A New Comprehensive Model

This dissertation conceives a comprehensive model that describes the time sequence of IPOs' institutional procedures. The model optimizes both issuer and investors on the time sequence.

### 8.2.1. New Definitions of Underpricing

The dissertation sheds new lights in the perspective from which IPO underpricing is studied. In addition to the traditional definition of underpricing, that is the position relating the first trading day closing price to the final offer price (*UTF*), two new definitions of underpricing are proposed: (1) *UFM* represents the position relating final offer price shown in the final prospectus to the mean of

initial filing price indicated in the red herring; and (2) *UTM* represents the position relating the first trading day closing price to the mean of high-low initial filing price range.

The significance of the new definitions is that the phenomenon of underpricing can now be examined at each stage of the IPO process, thus the relationship between underpricing and other relevant variables can be analyzed more precisely.

The empirical finding supports the author's assertion that the distance from the final offer price to the high or low end of the initial filing price indicates the market demand for the IPO being sold. While an IPO's initial filing price range is established before any market information on the demand for the share is gathered, the final offer price determination incorporates such information.

### 8.2.2. New Development in the IPO Market

The new model is developed based on the observation of two realities: (1) rapid development of the IPO new issue market and (2) improved qualities of new IPOs.

Empirical data show that the size of new issue market grew dramatically, increasing from $16 billion in 1987 to $30 billion in 1993. As the number of IPOs increased, the qualities of IPOs also kept upward. Low quality issues have experienced a learning curve and have less occurrence in the market. The IPO market becomes more developed and more positively perceived.

### 8.2.3. Redefining Investors: Experienced vs. Inexperienced

The model redefines investors according to their chances of getting IPO shares. Unlike the previous models that classify investors by some intangible criteria, such as the amount of information possessed, this model groups investors by the probabilities that they obtain IPO allocations in the primary market. Experienced investors are those who frequently get first priority from underwriters

to purchase IPOs. Such investors are regarded as the IPO club's regular members and their probabilities of obtaining allocations are much higher than others when oversubscription occurs. In reality, experienced investors are usually institutional investors who have resources to gather information from all possible sources on issuing companies and whose orders are substantially larger than that of individual retail investors.

Inexperienced investors, usually individual retail investors, have less chances to get allocations of IPOs in the primary market and usually have to make their purchases in the secondary market. These investors depend either on their own instincts or resources, or brokers' recommendations for purchasing decision. Since most individual investors have less capital power, they normally submit rather small orders (between 100 shares to 1,000 shares). In the best situation, individual investors' aggregate order is only about a quarter of total IPO transaction.

### 8.2.4. Internal and External Information

When a new issue is offered to the public, information important for investors to make purchasing decision is composed of two aspects: internal and external.

Internal information relates to the information revealing true value of an issuing firm, while external information relates to the market information which reflects the whole market condition.

At each stage of the IPO process, a different kind of information plays dominant role in influencing decision making. Internal information is the best estimation of the true value of the issuing company, including the company's historical performance, future plan, financial and accounting information. Therefore, internal information acts as the most important factor in establishing IPOs' initial filing price range. IPOs' initial discount, namely discount observed in the initial filing price range, is the consequence of the consensus reached between

issuer and underwriters upon the internal information processed under certain financial environment.

External information, the market's response to the new issue, and the market's previous reaction (demand) to issues with similar historical records and backgrounds, is vital in constituting IPO's offer price and first trading day closing price, therefore influencing the underpricing of *UTF*.

## 8.3. Implication of the Theoretical Model

The basic model infers investors' demand by deriving their utility-maximizing demand function. Based upon this demand, the issuer selects an optimal issue price to reach an equilibrium in which demand equals the total issued shares. The advanced model maximizes the likelihood of observed demand generated from road show to reach a conjectured demand. The final IPO price is selected base on this conjectured demand. The initial price range filed with the SEC is described as a way to generate information about unknown parameters and underwriting as a way to covering the residual risk of undersubscription that remains due to possible errors in parameters inference.

The model reveals that IPO underpricing is (1) an increasing function of demand; (2) an increasing function of the risk-free interest rate; (3) an increasing function of the aftermarket variance of the IPO; (4) an increasing function of investors' (absolute) risk aversion; (5) an increasing function of the number of IPO shares offered (as well as total proceeds); (6) an decreasing function of the expected aftermarket price of IPO and (7) an decreasing function of the offer price of IPO.

## 8.4. Phenomenon of IPO Underpricing Reconfirmed

### 8.4.1. Overall Underpricing

Empirical tests are conducted to prove the relationship between underpricing and institutional variable of demand as well as market variablesof risk free interest

rate and total proceeds, the proposition derived from the theoretical model on a sample of 531 IPOs issued in the United States from 1988 to 1993. According to the definition of *UTF*, 394 IPOs are underpriced, making up 74 percent of the sample, and 137 are overpriced, making up 26 percent of the sample. For the 394 underpriced IPOs, average underpricing is 15 percent. For the 137 overpriced issues, average overpricing is -3 percent. For the entire sample, average underpricing is 10 percent.

### 8.4.2. Distribution of Underpricing

On the first trading day, the best performed 1 percent IPO issues experience an initial return of 73 to 99 percent by definition of *UTF* while the worst performed 1 percent issues suffer a 13 percent to 27 percent loss. In other words, while most of the issues have returns centered around 10 percent, some issues produce extremely large initial returns thus causing the distribution of initial performance to skew to the right. Such an evidence suggests that the skewness of the initial return distribution is caused by outliers rather than the underwriter price support hypothesis (Ruud, 1993).

### 8.4.3. IPOs by Years of Offering

The number of firms going public is reversibly related to risk free interest rate. The number of issues offered to the public in 1989 and 1990 is the lowest, 35 and 41 respectively, corresponding to the two highest annual interest rates incurred during the period, 8.09 percent and 7.47 percent respectively. On the other hand, 1992 and 1993 saw the largest number of firms going public, 148 and 166 respectively, corresponding to the record low interest rates in two decades, 3.55 and 3.02 percent respectively.

### 8.4.4. IPOs by Industries

From the statistics of the sample, it is found that IPOs issued by banking

industry and heavy industry are less underpriced (6.9 and 5.8 percent respectively) in comparison with those by other two industries (11.5 percent for high-tech industry and 10 percent for light industry). Among all sectors, heavy industry has lowest underpricing and high-tech industry has the highest underpricing. This finding is in line with the results discovered by Ritter (1991).

Interest rates accompanying different industries' IPOs are found to be the same.

## 8.5. Results on the Relationship between Risk Free Interest Rate and Underpricing

The sample of this study is chosen for a six-year period during which interest rate experienced a high-low cycle, declining from the highest level of 8.83 percent in March, 1989 to the lowest level of 2.84 percent in October, 1992. A close examination of the IPO market during this period of time reveals a meaningful relationship between risk free interest rate and IPO underpricing, particularly for underpricing of *UTF*. The analysis on the impact of interest rate on underpricing shown in each stage concludes the following.

### 8.5.1. Higher Interest Rate More Likely Producing Underpriced IPOs

The result is significant on an one-side two-sample t-test comparing the prevailing interest rates accompanying the underpriced issues and overpriced issues among the *UTF* and *UTM* groups. The corresponding one-sided p-value is approximately 0.017 for *UTF* and 0.024 for *UTM*. Such a result suggests that for the sample period risk free interest rates are higher for the underpriced IPO group than for the overpriced IPO group, thus affirming the author's hypothesis that risk free interest rates are more likely higher when underpriced issues occur than when overpriced issues come to the market. In other words, higher interest rate is more

likely to introduce underpriced issues.

The results of the empirical test shows that interest rate does play a role in forming *UTF*. When purchasing IPOs on the first trading day, investors compare IPOs with other risk free vehicles. It can be concluded that IPO underpricing is an incentive for issuers to attract investors from alternate investment vehicles such as risk free government bonds. By offering initial returns higher than risk free money market interest rate, IPO issuers offer investors an alternate investment vehicle worthwhile buying. Underpricing of IPO is compensation to investors for their alternative investment.

### 8.5.2. No Difference in the Impact of Interest Rate on *UFM*

It is found that issues in the *UFM* group interest rates accompanying the underpriced issues and overpriced respectively are not significantly different. In the *UFM* group, the average interest rates are comparable for the IPOs whose final offer price is higher than the mean initial filing price and whose final offer price is lower than the mean initial filing price. On average the concurrent interest rate accompanying the underpriced IPO group is 4.65 percent, not much different from the average interest rate of 4.56 percent attending the overpriced group.

Such a finding verifies the author's hypothesis that the concerns on interest rate have already been taken into consideration prior to the determination of initial filing price. The time span between setting up of the initial filing price and final offering price is only two to three weeks, and in most cases interest rate would not change dramatically during such a short period of time. For this reason, the impact of interest rate on initial filing price and final offer price is not significantly different.

### 8.5.3. No Linear Relationship between Interest Rate and Underpricing

Based on the empirical results of both univariate and cross-sectional analysis, a linear relationship between interest rates and IPO initial returns can not be established. The results described in 8.5.1 implies that interest rate influences underpricing in a non-linear way.

## 8.6. Positive Relationship between Underpricing and Market Demand

In general, market demand is positively related to underpricing. While an IPO's initial filing price range is established before any market information is gathered, the first trading day price has to reflect the market demand during the road show for the new share. Therefore, underpricing defined by *UTF* is an immediate response to the market demand represented by the institutional variable demand index *UFM* in this analysis.

### 8.6.1. Relationship between Initial Return and Demand Index

Due to the difficulty of obtaining from underwriters the information on subscription which is usually considered confidential, a demand index defined as *UFM* is created to describe the demand for IPOs.

Since the demand index is defined as the position of the final offer price relative to the mean initial filing price net of market adjustment, only the relationships between underpricing *UTF* and demand index are examined.

A positive significant correlation is found between demand index (*UFM*) and underpricing (*UTF*) in univarite analysis. The R-square equals to 14 percent and F-statistic equals 89. The finding supports the author's assertion that using the regression model developed in this dissertation, one may obtain an estimate of the possible initial return once the final offer price is known. For instance, if an issuing firm's final offering price (*F*) is 1.5 times as large as the mean filing price (*M*). That is when *UFM*=0.5 one may expect a return of about 29.4 percent for the IPO's initial performance.

### 8.6.2. Projection of Probability of Underpricing with Demand Index

The demand index established in this dissertation can also be used to project the probability of underpricing. For instance, when the demand index *UFM* is greater than 0.0, meaning the final offer price is greater than the mean initial filing price, the probability is 80 percent for investors to draw a winning issue, meaning 80 percent possibility for the occurrence of underpricing and 20 percent for the occurrence of overpricing. While when the demand index *UFM* is smaller than 0.0, the probability of occurance of underpricing decreases to 70 percent and the probability of overpricing rises to 30 percent.

With the help of the demand index *UFM*, it is possible to exhibit the probability of drawing a winning issue accordingly. The empirical results show that the demand index *UFM* is a good proxy to indicate how well an IPO issue could perform on the first trading day.

## 8.7. Univariate Analysis Indicates Underpricing Is Not Correlated with Inverse of Total Proceeds

The univariate analysis shows that none of the three definitions of underpricing is statistically significant in correlation with total proceeds. Linear relation is not found between underpricing and total proceeds in the univariate test. However, cross-sectional analysis suggests that there be a significant linear relationship between underpricing and dependent variables, namely *UFM*, reciprocal of total proceeds (1/P) and interaction between *UFM* and (1/P).

The analysis reveals that on average IPOs from the banking industry have the highest average total proceeds (US$81 million). Following the banking industry, IPOs from the heavy industry have the second highest average total proceeds (US$66 million). IPOs from the light and high-tech industries have the lowest total proceeds (US$49 million and US$42 million respectively).

## 8.8. Results on Hot and Cold Market

### 8.8.1. Hot and Cold Market Observed

The observations of volumes of IPO issues appeared during the sample period ascertains the conception of hot and cold market which was conceived by Ritter (1984), namely the hot market is associated with relatively more IPO volumes and the cold market associated with fewer IPO volumes.

The observance of this sample also confirms that cycle of hot and cold market comes in waves. Of the sample, the cold market continued from the first quarter of 1988 to the first quarter of 1991, and the hot market began in the second quarter of 1991 and continued to the end of 1993 when the data was collected.

### 8.8.2. UTF and UTM Are Significantly Different in Hot and Cold Market

From the empirical test, it is concluded that in the whole sample for *UFM* the percentage of IPO issues with positive performance is similar in both cold and hot markets. But performance in the whole sample for *UTF* and *UTM* the percentage of IPO issues with positive is significantly different in the cold and hot market. Percentage of underpriced issues defined by *UTF* in the cold market is 82 percent, significantly higher than that in the hot market which is 71 percent at significance level of 0.02. While for UTM, underpricing in the hot market is 63 percent, significantly higher than that in the cold market which is 52 percent at significance level of 0.03.

### 8.8.3. Higher Interest Rate Gives Rise to Cold Market and Vice Versa

An analysis of the concurrent interest rates accompanying the two market status reveals that the number of IPO issues declines as the interest rate rises. Interest rate sustained in the cold market is significantly higher than that in the hot market. More specifically, the average interest rate in the cold market is equal to 7.30 percent with standard error equivalent to 0.08%, while the average interest

rate in the hot market is equal to 3.74 percent with standard error equivalent to 0.05%.

A two sample t-test comparing the differences of interest rates in the two market conditions shows t-statistic equal to 38.99 and the p-value less than 0.0001. Therefore, the difference in interest rates between the cold and hot market is strongly significant.

The results of the fitting Poisson regression model after adjusting time effect shows that interest rate is significantly inversely related to the number of IPOs coming to the market. On average, with one percent decrease of interest rate, number of IPOs increase by four for each calendar quarter.

### 8.8.4. Lower Interest Rate Serves as an Invitation for Firms Going Public

The finding suggests that low interest rate serves as a strong incentive for firms to go public. Of the sample studied, the number of issues offered to the public in 1989 and 1990 is the lowest, 35 and 41 respectively (annual total proceeds of $1 billion), corresponding to the two highest annual interest rate, 8.09 percent and 7.47 percent respectively. On the other hand, 1992 and 1993 witnessed the highest number of firms going public, 148 and 166 respectively (annual total proceeds of $10 billion), corresponding to the record low interest rate of 3.55 to 3.02 percent in two decades.

### 8.8.5. Underpricing as an Incentive in the Cold Market

The investigation on IPO underpricing under different market conditions shows that for *UFM* the fraction of IPO issues is similar in both cold and hot markets. However, for *UTF* and *UTM*, the fraction of IPO issues is significantly different under the different market conditions. Eighty-two percent issues are underpriced in the cold market, significantly higher than that in the hot market where only 71 percent of issues are underpriced.

It is obvious that in the cold market issue volumes are small, and small volumes make supply scare. On the other hand, because interest rate is high, investors are less motivated to invest in the volatile IPO market thus making demand to shrink. Hence, in the cold market, total wealth available to be invested in the IPO market is proportionally smaller too.

In the hot market condition where interest rate is low, investors are more willing to purchase IPOs, thus the total wealth available to the IPO market is larger. High demand consequently motivates more firms to make initial offerings.

The cold market is associated with small supply and proportionally smaller demand, and the hot market is associated with large demand and supply. Therefore, the ratio of the total wealth invested in the IPO market and total number of issues appeared in the cold market is similar to that in the hot market. Consequently, average initial return turns out to be similar in both the hot and cold market. This result is significant in proving the author's theoretical work that is underpricing is an incentive for issuers to stimulate demand in the cold market condition.

At the stage of determining initial filing price, which is described by *UFM*, without artificial effort the ratio of total supply and demand in the cold market is similar to that in the hot market. However, by the stage of setting up final offer price after road show, when confronted with the cold market condition more issuers lower their offer price or further discount their IPOs, thus stimulating demand. Such efforts cause instant rise of the fraction of underpriced cases and changes the market condition, in terms of *UTF* producing higher fraction of underpriced cases in the cold market than in the hot market. It can be concluded that when wealth available to be invested in IPOs is limited in the cold market, more issuing firms may have to underprice their shares to attract investors. While in the hot market, this may not be the case.

### 8.8.6. Other Findings on the Hot and Cold Market

The analysis shows that average total proceeds of each IPO in the hot and cold market are not significantly different (US$52 million vs US$37 million).

## 8.9. Cross-sectional Analysis

Cross-sectional analysis, which obtains additional insights into the relationship between initial performance and institutional variable of demand index and market variables of risk free interest rate, total (inverse) proceeds, hot/cold market factor, industry factor and interactions between variables shows that the model established in this dissertation leads to several meaningful conclusions. One important conclusion is that initial return is mostly related to certain variables in stage two but not in stage one.

The cross-sectional analysis concludes correlational relationships between underpricing *UTF* and demand index as well as reciprocal of total proceeds and the interaction between the demand index and inverse total proceeds.

The cross-sectional model suggests that the relationship between underpricing (*UTF*) and demand index (*UFM*) changes across different initial public offerings with different amount of total proceeds. The analysis reveals that increase in underpricing corresponding to the increase in demand depends on the size of the total proceeds of IPO. In general, given a fixed total proceeds, underpricing increases as demand increase; and given a fixed demand, underpricing increases as the total proceeds increase.

In summary, the cross-sectional analysis establishes a relationship between initial return (*UTF*) and demand index (*UFM*) and total proceeds suggested by the author's theoretical model. It is found that *UTF* is significantly and positively related to institutional variable *UFM*. However, the effect of *UFM* changes as total proceeds change. The multivariate model (Model 7.15) provides a tool to access the overall effect of the demand and total proceeds on the IPO underpricing.

The empirical analysis also concludes that the probability of drawing a winning issue is significantly higher when the demand index is positive than when the demand index is negative or zero.

**Accountant's Report**
A statement by the accounting firm setting forth the extent of its audit of the company's financial statements, the methods used, and its opinion as to the integrity of the statements. It will state that the accounting firm has used approved methods and standards of accumulating financial material in the document. It is normally found toward the back of the prospectus in the from of the financials.

**Allocation**
When demand is high, underwriters use the discretion to allocate new issue shares to their customers.

**Aftermarket Support**
See stabilization.

**Best Efforts Offering**
A type of underwriting agreement in which the underwriters agree to use their "best efforts" to sell the issue as the company's agent. If the underwriters cannot find purchasers, the issue is not sold.

**Bid and Ask Price**
The bid price is the highest price someone is willing to pay. The ask price is the lowest price at which someone is willing to sell.

**Blue Sky**
A common term for state securities laws. In addition to complying with the US federal laws, a company registering its securities must also register or find an exemption from registration under relevant state laws of any state in which the security is to be offered.

**Capitalization**
A company's debt and equity structure. It is also referred to total amount of securities issued by a company.

**Cheap Stock**
Common stock issued to selected persons prior to a public offering at a price less than the public offering price.

**Closing**
The meeting at which final documents are exchanged and the offering company receives its proceeds.

**Comfort Letter**
Letters that the company's accountant issues to the underwriter to assist with the underwriter's due diligence. These letters generally state that the company financial statement and other financial data are prepared in accordance with GAAP on a consistent base.

**Comment Letter**
The SEC's response to the initial or subsequent filings, stating the areas that have been found incomplete or for which further expansion is required.

**Due Diligence**
A standard of reasonable investigation by the company's underwriter, accountant or lawyer. The purpose of due diligence is to verify all disclosures and affirm that the presentations in the registration statement are true.

**Effective Date**
The day on which the registration statement becomes effective and actual sales of a registered offering can begin.

**Filing Date**
The date on which a company files its registration statement with the SEC.

**Final Offer Price**
The price to sold to the public including underwriting discounts and dealers' consensus and reallowances. It is typically agreed upon by the company and managing underwriter following the close of the market before the first trading day or the morning of the first trading day.

**Final Prospectus**
Prospectus that contains final offer price information and is distributed to investors.

**Firm Commitment Offering**
A type of underwriting agreement in which the underwriters agree to purchase al the shares being offered for the purpose of resale to the public. The underwriter must buy all the stock offered at a fixed price and resell it to the public. They must hold the shares for their own account if they are not successful in finding public purchasers.

**First Trading Day**
The first day when a security is traded on the market.

**GAAP**
Generally accepted accounting practice.

**Green Shoe**
See Overallotment Option.

**High-low Initial Offer Price Range**
See Initial Filing Price Range.

**Indications of Interest**
Demand on the security offered solicited by underwriters' sales personnel during the pre-marketing period.

**IPO**
Initial Public Offering.

**Initial Filing Price Range**
Initial filing price range filed with initial registration statement for the purpose of calculating SEC filing fee, or filed with the first amendment to the registration statement. Initial filing price range is printed on the cover of red herring and is used to solicit indications of interest from investors. The range usually has a spread of 10% to 20% of the filing price.

**Investment Bankers**
Specialists who advise companies on available sources of financing and optimal time for a public offering of securities, and they also act as underwriters for public offerings.

**Managing Underwriter**
Also known as lead underwriter or lead manager, managing underwriters organize the underwriting syndicate and act as the primary contact with the company.

**Market Maker**
The managing underwriters and syndicated underwriters who maintain bid and ask prices of a particular stock, helping to sustain financial community interest and providing aftermarket support for a company's stock.

**Market Practice**
Common practice at Wall Street that are carried out in compliance with regulations when there are no specific guidelines are provided by the SEC.

**Market Valuation**
The total amount of a company's outstanding shares multiplied by the stock price.

**Mid Point of Initial Filing Price Range**
Mid point of filing price range is mean of high-end plus low-end, and serves as a benchmark of the range.

**NASD**
National Association of Securities Dealers, Inc.. Among other things, the

organization reviews underwriters' remuneration arrangements for all public offerings to challenge whether they are fair and reasonable.

**NASDAQ**
National Association of Securities Dealers Automated Quotation System, an automated trading and information system that provides price, volume, and trade information on securities traded over-the-counter.

**Organizational Meeting**
The full assemblage of an offering team, including company officers, the company's lawyer and accountant, the underwriter, and underwriter's counsel.

**Overallotment Option** (also known as Green Shoe Option)
A provision that gives the underwriter an option to acquire an additional amount of shares from he issuer, up to 15 percent of the number of shares issued within 30 days of the offering date.

**Overpricing**
When the first trades of the newly issued stock trade below the offer price.

**Major Parties In IPOs**
Issuer, issuer's counsel, underwriters, underwriters' counsel, independent accountants, and sometimes including technical consultants and public relation experts.

**Pre-Marketing**
The period from distributing red herring to the registration statement is declared effective. During this period, oral selling efforts are undertaken by underwriters' sales personnel.

**Price Amendment**
The registration statement that specifies the initial price at which the stock will be sold to the public. This is usually the last filing, made after the SEC has reviewed all prior amendments.

**Price-Earnings Ratio**
The price of a share of common stock divided by earnings per share.

**Pro Forma**
A financial presentation that reflects the anticipated effects of a particular transaction.

**Prospectus**
The printed document used to sell shares to the public. It is usually Part I of the registration statement, disclosing information about the company and the offering and is distributed as a separate document to prospective investors.

**Quiet Period**
Technically, the time between reaching an understanding with the underwriter to go public and 90 days after the first sale of the stock. Promotion of the company is subject to restraints detailed by the SEC.

**Red Herring**
The preliminary prospectus, which is required to have a legend in red type on the front, declares that a registration statement has been filed with the SEC, that the prospectus is subject to completion or amendment. Red herring cannot confirm an offer to buy or sell, but may be distributed to potential investors and it is circulated during the quiet period.

**Registration Statement**
The disclosure document filed with the SEC, consisting of a prospectus and all other disclosures, for securities offered under the 1933 Act.

**Regulation S-K**
Regulations governing non-financial statement related disclosures in both registration statements and periodic reports (other than small business issuers).

**Regulation S-X**
SEC regulation that establishes the requirements for financial statements, independent audits and financial information included in non small business registration statements.

**Road Show**
The tour lasting for one to two weeks in order to generate interest in an offering among analysts and investors during the quiet period.

**SEC**
Securities and Exchange Commission.

**Securities Act of 1933 (1933 Act)**
An act that requires that public offerings of securities be registered with the SEC before they may be sold.

**Securities Exchange Act 1943 (1934 Act)**
Regulates securities exchange s and over-the-counter markets. Also, generally requires publicly held companies to file periodic reports with the SEC.

**Short Sale**
Selling a borrowed stock with the intention of repurchasing it after the price goes down.

**Stabilization**
The act of an underwriter who purchases stock of a new issue at or below its offering price in an attempt to stabilize the price.

**Syndicate**
Underwriter who form a group to offer securities.

**Tombstone**
Advertisement of the offering during the quiet period that is permitted. Tombstone states only the issuing company's name, the title and under of shares being offered and where the prospectus may be obtained. Companies customarily place these ads after the effective date, when more information may be included.

**Top Bracket Investment Banks**
The first bracket of investment banks that appear in tombstone advertisements. Six US investment banks are ranked in this bracket, namely Merrill Lynch, Lehman Brothers, Morgan Stanley, Goldman Sachs, CS First Boston, and Salomon Brothers.

**Underpricing**
When the first trades of the newly issued stock trades above the offer price.

**Underwriter**
A securities dealer who agrees to buy the securities from the issuing company and resell them to the public. The term managing underwriter or representative refers to the underwriter leading the underwriting syndicate.

**Underwriting Agreement**
A binding contract between the underwriter and the company, normally signed within 24 hours of the expected effective date of the offering. It contains the details of the company's arrangements with the underwriters, including the type of underwriting, the underwriters' compensation, the offering price and number of shares.

**Underwriting Syndicate**
The list of underwriters found in the prospectus, and is a part of the Underwriting Agreement. The syndicate is the group of security dealers who agree to work with and share the risks of the managing underwriter in buying the security from the issuing company and reselling it to the public.

**Valuation**
See Market Valuation.

**Waiting Period**
The time between the initial filing of the registration and the effective date.

Appendex I
Data for the Empirical Study

| | Issuer | Offer Date | Low Initial Filing Price | High Initial Filing Price | Final Offer Price | First Trading Day Closing Price | Total Shares Offered Globally (000') | Three Month T Bill Rate | DJIA at Offer Date | DJIA at Red Herring Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | IMC Fertilizer Group | 01/26/88 | 20.00 | 22.00 | 22.00 | 23.00 | 10,000 | 5.81% | 1920.59 | 1903.51 |
| 2 | Houston Biomedical | 01/29/88 | 5.00 | 5.00 | 5.00 | 4.75 | 440 | 5.81% | 1958.22 | 2051.90 |
| 3 | Belmac | 02/02/88 | 5.00 | 5.00 | 5.00 | 4.75 | 700 | 5.66% | 1952.92 | 2031.40 |
| 4 | Octel Communications | 02/26/88 | 6.00 | 7.00 | 7.00 | 9.00 | 2,100 | 5.66% | 2023.21 | 1903.51 |
| 5 | Maxim Integrated Produ | 02/29/88 | 6.00 | 7.50 | 5.50 | 6.00 | 2,000 | 5.66% | 2071.62 | 1903.51 |
| 6 | VitaLink Communicatio | 03/04/88 | 7.00 | 8.50 | 8.25 | 9.00 | 2,000 | 5.70% | 2057.86 | 2005.97 |
| 7 | Gruene | 03/08/88 | 6.00 | 6.00 | 6.00 | 7.75 | 500 | 5.70% | 2080.90 | 1895.72 |
| 8 | Varitronic Systems Inc | 03/15/88 | 9.00 | 11.00 | 11.00 | 15.38 | 1,200 | 5.70% | 2047.41 | 1986.41 |
| 9 | Mallard Coach | 03/18/88 | 8.00 | 10.00 | 8.00 | 8.00 | 2,150 | 5.70% | 2087.37 | 2039.12 |
| 10 | Avondale Industries | 03/30/88 | 15.00 | 18.00 | 15.00 | 14.75 | 5,500 | 5.70% | 1978.12 | 2005.97 |
| 11 | Cease Fire | 04/06/88 | 5.00 | 5.00 | 5.00 | 5.38 | 1,000 | 5.91% | 2061.67 | 2026.03 |
| 12 | Conner Peripherals | 04/12/88 | 8.50 | 9.50 | 8.00 | 8.25 | 5,000 | 5.91% | 2110.08 | 2080.90 |
| 13 | Community Bancshares | 05/04/88 | 7.00 | 9.00 | 7.25 | 7.25 | 1,000 | 6.26% | 2036.31 | 2005.64 |
| 14 | Respironics | 05/16/88 | 11.00 | 13.00 | 12.00 | 13.25 | 500 | 6.26% | 2007.63 | 1978.12 |
| 15 | Compumat | 05/17/88 | 4.50 | 5.50 | 4.75 | 4.75 | 800 | 6.26% | 1986.41 | 2090.19 |
| 16 | Timberjack | 05/24/88 | 12.00 | 12.00 | 12.00 | 11.88 | 1,150 | 6.26% | 1962.53 | 2007.46 |
| 17 | Medstone International | 06/02/88 | 11.00 | 13.00 | 13.00 | 18.25 | 1,000 | 6.46% | 2052.45 | 1985.41 |
| 18 | Harvard Knitwear | 06/16/88 | 5.25 | 5.25 | 5.25 | 5.00 | 900 | 6.46% | 2094.24 | 2107.10 |
| 19 | Dell Computer | 06/22/88 | 8.00 | 9.50 | 8.50 | 9.75 | 3,500 | 6.46% | 2152.20 | 1956.44 |
| 20 | General Microelectronic | 06/22/88 | 4.50 | 5.50 | 4.00 | 3.88 | 1,250 | 6.46% | 2152.20 | 2131.40 |
| 21 | Gaylord Container | 06/29/88 | 26.00 | 30.00 | 20.50 | 20.88 | 3,800 | 6.46% | 2121.98 | 2093.53 |
| 22 | Chaparral Steel | 07/07/88 | 14.00 | 16.00 | 15.00 | 15.00 | 5,400 | 6.73% | 2122.69 | 2064.01 |
| 23 | Concord Camera | 07/12/88 | 4.50 | 6.50 | 5.00 | 5.25 | 1,000 | 6.73% | 2092.64 | 2093.53 |
| 24 | Apogee Technology | 07/15/88 | 6.00 | 6.00 | 6.00 | 8.13 | 600 | 6.73% | 2129.45 | 1956.44 |
| 25 | Tuscarora Plastics | 07/21/88 | 14.00 | 16.00 | 15.50 | 17.75 | 394 | 6.73% | 2086.59 | 2083.93 |
| 26 | American Power Conve | 07/22/88 | 6.75 | 7.75 | 7.50 | 7.50 | 775 | 6.73% | 2060.99 | 2130.87 |
| 27 | Columbia Laboratories | 07/28/88 | 3.00 | 3.00 | 3.00 | 3.38 | 1,350 | 6.73% | 2082.32 | 2031.12 |
| 28 | Smithfield Companies | 08/09/88 | 9.00 | 10.00 | 9.50 | 9.63 | 625 | 7.06% | 2079.13 | 2060.99 |
| 29 | NeoRx | 08/11/88 | 7.00 | 9.00 | 7.00 | 7.13 | 2,500 | 7.06% | 2039.30 | 2053.70 |
| 30 | Novellus Systems | 08/11/88 | 7.00 | 9.00 | 8.00 | 8.13 | 1,900 | 7.06% | 2039.30 | 2104.37 |
| 31 | Gitano Group | 09/30/88 | 19.00 | 22.00 | 20.50 | 20.25 | 2,500 | 7.24% | 2112.70 | 1989.33 |
| 32 | Selfix | 10/05/88 | 8.25 | 9.25 | 7.00 | 7.00 | 1,000 | 7.35% | 2106.51 | 2016.00 |
| 33 | BioAnalogics | 10/11/88 | 3.00 | 3.00 | 3.00 | 4.63 | 1,350 | 7.35% | 2156.47 | 2063.10 |
| 34 | Lindsay Manufacturing | 10/12/88 | 11.00 | 13.00 | 10.00 | 10.25 | 1,200 | 7.35% | 2126.24 | 2090.70 |
| 35 | Midwest Grain Products | 10/20/88 | 13.00 | 15.00 | 14.00 | 14.75 | 1,100 | 7.35% | 2181.19 | 2090.70 |
| 36 | Beckman Instruments | 11/04/88 | 20.00 | 23.00 | 19.00 | 19.00 | 4,500 | 7.76% | 2145.80 | 2082.30 |
| 37 | Metro Bancshares | 11/04/88 | 8.50 | 11.50 | 8.75 | 8.88 | 486 | 7.76% | 2145.80 | 2133.18 |
| 38 | Genus | 11/10/88 | 10.50 | 10.50 | 5.00 | 5.13 | 2,000 | 7.76% | 2114.70 | 2106.51 |
| 39 | Wellington Leisure Prod | 12/08/88 | 10.00 | 12.00 | 9.50 | 9.75 | 750 | 8.07% | 2141.70 | 2101.90 |
| 40 | Hitox Corporation of Am | 12/14/88 | 10.00 | 12.00 | 8.50 | 8.50 | 1,200 | 8.07% | 2134.30 | 2074.70 |
| 41 | Bliss & Laugh in Industri | 12/15/88 | 11.00 | 13.00 | 10.50 | 10.63 | 850 | 8.07% | 2133.00 | 2038.60 |
| 42 | International Barrier | 12/16/88 | 7.00 | 7.75 | 7.00 | 7.38 | 715 | 8.07% | 2150.70 | 2145.80 |
| 43 | FSI International | 01/19/89 | 8.00 | 10.00 | 7.50 | 7.50 | 1,450 | 8.27% | 2239.11 | 2199.46 |
| 44 | BTU International | 02/07/89 | 8.00 | 10.00 | 8.00 | 8.38 | 1,700 | 8.53% | 2347.14 | 2256.89 |
| 45 | Clinical Technologies A | 02/09/89 | 5.00 | 5.00 | 5.00 | 5.13 | 775 | 8.53% | 2323.04 | 2291.07 |
| 46 | BT Telecom | 02/16/89 | 6.50 | 6.50 | 5.50 | 6.75 | 1,600 | 8.53% | 2311.43 | 2218.39 |
| 47 | American Body Armor & | 03/14/89 | 3.00 | 4.00 | 4.00 | 5.50 | 1,000 | 8.82% | 2306.25 | 2238.75 |
| 48 | Presstek | 03/28/89 | 5.00 | 5.00 | 5.00 | 5.38 | 1,300 | 8.82% | 2275.54 | 2243.04 |
| 49 | Bytex | 04/13/89 | 8.00 | 10.00 | 8.00 | 8.00 | 1,350 | 8.65% | 2296.00 | 2258.39 |
| 50 | ChemDesign | 04/26/89 | 12.00 | 14.00 | 13.50 | 16.00 | 2,750 | 8.65% | 2389.11 | 2258.39 |
| 51 | Wildey | 05/04/89 | 5.00 | 5.00 | 5.00 | 5.25 | 700 | 8.43% | 2384.90 | 2337.06 |
| 52 | Comptronix | 05/18/89 | 4.50 | 5.50 | 5.00 | 5.63 | 2,000 | 8.43% | 2470.12 | 2337.79 |
| 53 | Unitog | 05/18/89 | 11.00 | 13.00 | 12.25 | 14.75 | 1,600 | 8.43% | 2470.12 | 2291.97 |
| 54 | IDEX | 06/02/89 | 15.00 | 18.00 | 14.50 | 14.63 | 3,300 | 8.15% | 2516.90 | 2389.11 |
| 55 | T/SF Communications | 06/08/89 | 10.50 | 12.50 | 12.00 | 12.38 | 2,100 | 8.15% | 2516.90 | 2502.02 |
| 56 | MagneTek | 06/13/89 | 12.00 | 15.00 | 12.00 | 12.00 | 5,250 | 8.15% | 2503.50 | 2501.10 |

| | Issuer | Offer Date | Low Initial Filing Price | High Initial Filing Price | Final Offer Price | First Trading Day Closing Price | Total Shares Offered Globally (000') | Three Month T Bill Rate | DJIA at Offer Date | DJIA at Red Herring Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 57 | Weirton Steel | 06/14/89 | 14.00 | 16.00 | 14.50 | 15.13 | 4,000 | 8.15% | 2503.40 | 2371.33 |
| 58 | Bali Jewelry | 06/21/89 | 2.50 | 2.50 | 2.50 | 2.88 | 2,000 | 8.15% | 2464.91 | 2402.86 |
| 59 | Rexhall Industries | 06/22/89 | 6.00 | 6.00 | 6.00 | 6.00 | 1,000 | 8.15% | 2482.17 | 2453.45 |
| 60 | Synetic | 06/28/89 | 9.00 | 11.00 | 10.50 | 11.13 | 1,800 | 8.15% | 2504.74 | 2501.10 |
| 61 | Sports-Tech Internation | 06/28/89 | 5.00 | 5.00 | 5.00 | 5.13 | 500 | 8.15% | 2504.74 | 2482.17 |
| 62 | Cognex | 07/20/89 | 8.50 | 10.00 | 11.00 | 11.13 | 1,161 | 7.88% | 2575.50 | 2553.40 |
| 63 | Smith Corona | 07/28/89 | 23.00 | 25.00 | 21.00 | 21.00 | 14,750 | 7.88% | 2635.24 | 2480.70 |
| 64 | First City Bancorp | 09/21/89 | 10.50 | 12.00 | 10.50 | 10.50 | 625 | 7.75% | 2680.28 | 2693.29 |
| 65 | Surgical Laser Technol | 09/29/89 | 9.50 | 11.50 | 12.50 | 15.50 | 1,625 | 7.75% | 2692.82 | 2686.08 |
| 66 | Neurogen | 10/03/89 | 5.00 | 6.50 | 6.00 | 7.13 | 1,200 | 7.64% | 2754.56 | 2681.61 |
| 67 | Amtech | 11/08/89 | 12.00 | 14.00 | 13.00 | 14.38 | 1,600 | 7.69% | 2623.36 | 2569.26 |
| 68 | Mass Microsystems | 11/09/89 | 4.25 | 5.00 | 6.00 | 6.25 | 1,635 | 7.69% | 2603.69 | 2569.26 |
| 69 | Solectron | 11/15/89 | 7.50 | 9.00 | 6.00 | 6.25 | 1,850 | 7.69% | 2632.58 | 2653.28 |
| 70 | Gehl | 11/21/89 | 13.00 | 15.00 | 14.00 | 13.88 | 2,200 | 7.69% | 2639.29 | 2657.38 |
| 71 | Yes Clothing | 11/21/89 | 8.00 | 8.50 | 8.50 | 8.50 | 776 | 7.69% | 2639.29 | 2610.25 |
| 72 | Laserscope | 11/30/89 | 6.50 | 8.00 | 9.00 | 11.38 | 1,814 | 7.69% | 2706.27 | 2662.91 |
| 73 | Sun Sportswear | 12/06/89 | 10.00 | 12.00 | 10.50 | 10.50 | 1,700 | 7.63% | 2736.77 | 2662.91 |
| 74 | First Brands | 12/13/89 | 19.00 | 22.00 | 19.00 | 19.00 | 6,475 | 7.63% | 2761.09 | 2731.44 |
| 75 | G-III Apparel Group | 12/14/89 | 13.00 | 16.00 | 13.00 | 13.50 | 2,000 | 7.63% | 2753.63 | 2752.13 |
| 76 | PolyGram | 12/14/89 | 16.00 | 20.00 | 16.00 | 16.88 | 32,000 | 7.63% | 2753.63 | 2675.55 |
| 77 | MIPS Computer System | 12/21/89 | 14.00 | 17.00 | 17.50 | 19.00 | 4,600 | 7.63% | 2691.13 | 2597.13 |
| 78 | Henley International | 02/02/90 | 8.00 | 10.00 | 8.00 | 8.00 | 1,000 | 7.74% | 2602.70 | 2695.61 |
| 79 | US Bioscience Inc. | 02/08/90 | 10.25 | 10.25 | 9.00 | 9.50 | 4,000 | 7.74% | 2644.40 | 2622.50 |
| 80 | Cisco Systems | 02/16/90 | 13.50 | 15.50 | 18.00 | 22.25 | 2,800 | 7.74% | 2635.59 | 2606.30 |
| 81 | Digital Sound | 02/27/90 | 6.50 | 8.00 | 8.50 | 9.50 | 4,700 | 7.74% | 2617.12 | 2553.38 |
| 82 | Hologic | 03/01/90 | 11.00 | 13.00 | 14.00 | 19.13 | 1,200 | 7.90% | 2635.59 | 2617.12 |
| 83 | Verifone | 03/13/90 | 12.00 | 14.00 | 16.00 | 19.25 | 3,900 | 7.90% | 2674.55 | 2586.30 |
| 84 | DeVlieg-Bullard | 03/16/90 | 13.00 | 13.00 | 7.00 | 7.13 | 5,350 | 7.90% | 2741.22 | 2674.55 |
| 85 | Geneva Steel | 03/27/90 | 14.00 | 16.00 | 10.00 | 10.00 | 7,750 | 7.90% | 2736.94 | 2707.66 |
| 86 | Syntellect | 03/29/90 | 11.50 | 13.00 | 15.00 | 18.38 | 1,865 | 7.90% | 2727.70 | 2707.66 |
| 87 | Advanced Logic Resear | 04/11/90 | 11.00 | 13.00 | 13.00 | 15.25 | 3,000 | 7.77% | 2729.70 | 2649.55 |
| 88 | RMI Titanium Co | 04/12/90 | 19.00 | 22.00 | 12.50 | 12.63 | 7,500 | 7.77% | 2751.80 | 2722.10 |
| 89 | Craftmade International | 04/17/90 | 1.25 | 3.25 | 3.50 | 4.38 | 1,000 | 7.77% | 2765.77 | 2721.20 |
| 90 | Orbital Sciences | 04/24/90 | 12.00 | 15.00 | 14.00 | 14.00 | 2,400 | 7.77% | 2654.50 | 2738.74 |
| 91 | Wahlco Environmental | 04/25/90 | 10.50 | 13.50 | 13.00 | 13.38 | 3,100 | 7.77% | 2666.44 | 2635.59 |
| 92 | Telebit | 04/27/90 | 9.00 | 10.50 | 10.00 | 11.50 | 2,090 | 7.77% | 2645.05 | 2602.48 |
| 93 | Aspect Telecommunicat | 05/01/90 | 11.00 | 13.00 | 14.50 | 15.25 | 2,000 | 7.74% | 2668.92 | 2695.72 |
| 94 | RasterOps | 05/09/90 | 9.00 | 11.00 | 12.00 | 14.88 | 1,870 | 7.74% | 2732.88 | 2645.05 |
| 95 | Mr. Coffee | 05/31/90 | 9.00 | 11.00 | 10.00 | 11.13 | 4,000 | 7.74% | 2876.66 | 2666.67 |
| 96 | Fleer | 06/05/90 | 11.00 | 13.00 | 15.00 | 20.25 | 1,700 | 7.73% | 2925.00 | 2763.06 |
| 97 | Gensia Pharmaceuticals | 06/05/90 | 9.00 | 11.00 | 11.00 | 11.13 | 2,800 | 7.73% | 2925.00 | 2822.45 |
| 98 | Digital Systems Internati | 06/08/90 | 15.00 | 17.00 | 18.00 | 22.13 | 2,200 | 7.73% | 2862.38 | 2676.58 |
| 99 | Xilinx | 06/12/90 | 6.00 | 8.00 | 10.00 | 14.00 | 2,500 | 7.73% | 2933.42 | 2645.05 |
| 100 | Helix BioCore | 06/13/90 | 1.50 | 3.50 | 3.50 | 5.25 | 1,600 | 7.73% | 2929.95 | 2733.56 |
| 101 | Arctco | 06/26/90 | 10.00 | 12.00 | 11.00 | 11.63 | 3,200 | 7.73% | 2842.33 | 2820.92 |
| 102 | Benchmark Electronics | 06/28/90 | 8.25 | 10.25 | 8.75 | 8.63 | 1,100 | 7.73% | 2878.71 | 2822.45 |
| 103 | Crest Industries | 06/29/90 | 7.00 | 7.00 | 6.75 | 7.63 | 1,200 | 7.73% | 2880.69 | 2668.92 |
| 104 | Horsehead Resource D | 06/29/90 | 10.00 | 12.00 | 14.50 | 18.00 | 3,250 | 7.73% | 2880.69 | 2933.42 |
| 105 | Orthopedic Services | 07/10/90 | 13.00 | 15.00 | 16.00 | 16.50 | 3,000 | 7.62% | 2890.84 | 2935.89 |
| 106 | Winners Circle | 07/10/90 | 4.00 | 6.00 | 6.00 | 5.88 | 650 | 7.62% | 2890.84 | 2911.65 |
| 107 | Environmental Elements | 07/13/90 | 14.00 | 16.00 | 16.50 | 20.50 | 2,475 | 7.62% | 2980.20 | 2820.92 |
| 108 | Wisconsin Pharmacal | 07/19/90 | 5.00 | 6.00 | 6.00 | 6.63 | 1,100 | 7.62% | 2993.81 | 2878.56 |
| 109 | Trimble Navigation | 07/20/90 | 8.00 | 10.00 | 10.00 | 10.38 | 3,000 | 7.62% | 2961.14 | 2933.42 |
| 110 | IKOS Systems | 07/25/90 | 6.00 | 7.50 | 6.50 | 6.50 | 3,117 | 7.62% | 2930.94 | 2890.84 |
| 111 | Lunar | 08/14/90 | 14.00 | 16.00 | 12.00 | 13.25 | 1,250 | 7.45% | 2747.77 | 2857.18 |

| | Issuer | Offer Date | Low Initial Filing Price | High Initial Filing Price | Final Offer Price | First Trading Day Closing Price | Total Shares Offered Globally (000') | Three Month T Bill Rate | DJIA at Offer Date | DJIA at Red Herring Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 112 | Regenex | 08/16/90 | 3.00 | 3.00 | 3.00 | 2.75 | 1,000 | 7.45% | 2681.44 | 2929.95 |
| 113 | Vital Signs | 08/29/90 | 12.50 | 14.50 | 10.00 | 10.13 | 1,275 | 7.45% | 2632.43 | 2980.20 |
| 114 | Ringer | 09/19/90 | 4.75 | 6.15 | 4.88 | 5.13 | 1,000 | 7.36% | 2557.43 | 2864.60 |
| 115 | Everest Medical | 12/06/90 | 4.00 | 4.00 | 3.75 | 4.75 | 1,000 | 6.74% | 2602.48 | 2610.40 |
| 116 | Digital Biometrics, Inc. | 12/07/90 | 1.00 | 3.00 | 3.00 | 3.00 | 700 | 6.74% | 2590.10 | 2565.35 |
| 117 | Air-Cure Environmental | 12/14/90 | 5.10 | 5.10 | 5.10 | 5.13 | 800 | 6.74% | 2593.81 | 2586.14 |
| 118 | In Focus Systems | 12/20/90 | 8.50 | 8.50 | 9.50 | 11.25 | 2,558 | 6.74% | 2629.46 | 2535.40 |
| 119 | MBNA | 01/22/91 | 23.00 | 25.00 | 22.50 | 23.25 | 38,295 | 6.22% | 2603.22 | 2596.78 |
| 120 | Cygnus Therapeutic Sy | 01/31/91 | 9.00 | 11.00 | 9.00 | 11.75 | 3,000 | 6.22% | 2736.39 | 2633.66 |
| 121 | Advanced Photonix | 02/11/91 | 6.00 | 6.00 | 6.00 | 9.50 | 1,000 | 5.94% | 2902.23 | 2527.23 |
| 122 | Zilog | 02/27/91 | 10.00 | 12.00 | 11.00 | 12.63 | 2,000 | 5.94% | 2889.11 | 2730.69 |
| 123 | Simtek | 03/06/91 | 5.00 | 6.00 | 6.10 | 6.25 | 1,950 | 5.91% | 2973.27 | 2932.18 |
| 124 | R & B | 03/12/91 | 14.00 | 14.00 | 7.63 | 8.00 | 1,500 | 5.91% | 2922.52 | 2864.60 |
| 125 | Deprenyl Animal Health | 03/14/91 | 3.00 | 3.00 | 3.00 | 3.00 | 1,800 | 5.91% | 2952.23 | 2887.87 |
| 126 | Atmel | 03/19/91 | 12.00 | 14.00 | 13.00 | 13.00 | 4,500 | 5.91% | 2867.82 | 2874.75 |
| 127 | Seismed Instruments | 03/20/91 | 4.50 | 4.50 | 4.50 | 7.25 | 900 | 5.91% | 2872.03 | 2603.22 |
| 128 | AMSCO International | 03/26/91 | 12.00 | 14.00 | 14.00 | 15.25 | 5,850 | 5.91% | 2914.85 | 2934.65 |
| 129 | Robern Apparel | 04/03/91 | 2.50 | 2.50 | 2.50 | 2.63 | 1,600 | 5.65% | 2926.73 | 2865.84 |
| 130 | Cybernetics Products | 04/10/91 | 3.00 | 3.00 | 3.00 | 2.75 | 1,500 | 5.65% | 2874.50 | 2945.05 |
| 131 | LXE | 04/11/91 | 8.00 | 9.50 | 9.50 | 12.88 | 1,100 | 5.65% | 2905.45 | 2896.78 |
| 132 | Brooktree | 04/17/91 | 10.00 | 12.00 | 12.00 | 17.00 | 3,500 | 5.65% | 3004.46 | 2955.20 |
| 133 | Sierra Semiconductor | 04/24/91 | 11.00 | 13.00 | 16.00 | 16.25 | 2,000 | 5.65% | 2949.51 | 2948.27 |
| 134 | Cephalon | 04/25/91 | 17.00 | 19.00 | 18.00 | 18.00 | 3,300 | 5.65% | 2921.04 | 2948.27 |
| 135 | Ballistivet | 04/30/91 | 3.50 | 3.50 | 3.50 | 5.38 | 1,775 | 5.65% | 2887.87 | 2662.62 |
| 136 | Applied Immune Scienc | 05/02/91 | 10.00 | 12.00 | 12.00 | 12.00 | 2,600 | 5.56% | 2938.61 | 2930.45 |
| 137 | Chipcom | 05/03/91 | 10.00 | 12.00 | 12.00 | 14.25 | 1,550 | 5.56% | 2938.86 | 2858.91 |
| 138 | MedImmune | 05/08/91 | 8.50 | 10.00 | 9.25 | 11.00 | 2,500 | 5.56% | 2930.90 | 2855.45 |
| 139 | Danek Group | 05/16/91 | 12.00 | 14.00 | 15.00 | 18.50 | 1,800 | 5.56% | 2894.01 | 2913.86 |
| 140 | ImmuLogic Pharmaceut | 05/22/91 | 14.00 | 16.00 | 10.00 | 10.00 | 2,000 | 5.56% | 2910.33 | 2917.49 |
| 141 | Scigenics | 05/23/91 | 22.00 | 24.00 | 22.00 | 22.00 | 1,818 | 5.56% | 2900.04 | 2921.04 |
| 142 | Moorco International | 06/04/91 | 14.00 | 16.00 | 14.25 | 15.75 | 6,400 | 5.71% | 3027.95 | 2958.86 |
| 143 | Proteon | 06/04/91 | 9.00 | 11.00 | 10.00 | 10.13 | 3,100 | 5.71% | 3027.95 | 2958.86 |
| 144 | Cherokee | 06/05/91 | 7.00 | 9.00 | 6.50 | 6.50 | 2,500 | 5.71% | 3005.37 | 2900.04 |
| 145 | Cambridge Neuroscienc | 06/06/91 | 15.00 | 17.00 | 12.00 | 11.00 | 2,000 | 5.71% | 2994.86 | 2913.91 |
| 146 | ICOS | 06/06/91 | 8.00 | 10.00 | 8.00 | 8.00 | 4,500 | 5.71% | 2994.86 | 2900.04 |
| 147 | AudioScience | 06/11/91 | 3.75 | 4.63 | 4.13 | 4.38 | 1,250 | 5.71% | 2985.91 | 2876.98 |
| 148 | Pulse Engineering | 06/11/91 | 10.00 | 12.00 | 10.50 | 10.25 | 2,550 | 5.71% | 2985.91 | 2912.38 |
| 149 | American Dental Laser | 06/18/91 | 11.00 | 13.00 | 13.00 | 15.63 | 2,100 | 5.71% | 2986.81 | 2949.51 |
| 150 | Integrated Circuit Syste | 06/20/91 | 9.00 | 11.00 | 8.25 | 8.25 | 1,300 | 5.71% | 2953.94 | 2941.64 |
| 151 | Medarex | 06/20/91 | 6.00 | 7.00 | 6.00 | 6.00 | 2,300 | 5.71% | 2953.94 | 2910.33 |
| 152 | IDEXX Corp | 06/21/91 | 18.50 | 18.50 | 15.00 | 15.13 | 1,600 | 5.71% | 2965.56 | 2930.90 |
| 153 | Insignia Systems | 06/25/91 | 3.625 | 3.625 | 3.63 | 3.63 | 1,400 | 5.71% | 2910.11 | 2910.33 |
| 154 | Advanced Promotion T | 06/26/91 | 4.00 | 6.00 | 6.00 | 8.00 | 3,000 | 5.71% | 2913.01 | 2886.63 |
| 155 | COR Therapeutics | 06/27/91 | 7.00 | 9.00 | 7.50 | 8.13 | 2,000 | 5.71% | 2934.93 | 2886.63 |
| 156 | Riddell Sports | 06/27/91 | 8.00 | 10.00 | 8.00 | 8.00 | 2,000 | 5.71% | 2934.93 | 3027.50 |
| 157 | Curative Technologies | 06/28/91 | 7.00 | 9.00 | 7.50 | 7.75 | 3,000 | 5.71% | 2906.75 | 3027.50 |
| 158 | Fruehauf Trailer | 06/28/91 | 14.00 | 16.00 | 11.00 | 10.38 | 4,000 | 5.71% | 2906.75 | 2986.88 |
| 159 | Revell-Monogram | 07/10/91 | 8.00 | 10.00 | 9.00 | 10.13 | 2,375 | 5.75% | 2944.77 | 2900.04 |
| 160 | Kaiser Aluminum | 07/11/91 | 20.00 | 22.00 | 14.00 | 14.25 | 7,250 | 5.75% | 2959.75 | 2910.11 |
| 161 | Alkermes | 07/16/91 | 9.00 | 11.00 | 10.00 | 11.00 | 1,750 | 5.75% | 2983.90 | 2913.01 |
| 162 | Micronics Computers | 07/17/91 | 7.00 | 9.00 | 6.00 | 6.25 | 3,000 | 5.75% | 2978.76 | 2906.75 |
| 163 | Aerodyne Products | 07/18/91 | 6.50 | 6.50 | 6.50 | 6.38 | 600 | 5.75% | 3016.32 | 2947.23 |
| 164 | Enquirer/Star Group | 07/19/91 | 16.00 | 18.00 | 14.00 | 14.00 | 13,500 | 5.75% | 3016.32 | 2886.63 |
| 165 | Sports Media | 07/23/91 | 5.00 | 5.00 | 5.00 | 4.88 | 750 | 5.75% | 2983.23 | 3035.33 |
| 166 | Interstate Bakeries | 07/24/91 | 16.00 | 18.00 | 16.00 | 16.00 | 15,625 | 5.75% | 2966.23 | 2913.91 |
| 167 | Vertex Pharmaceuticals | 07/24/91 | 9.00 | 11.00 | 9.00 | 9.00 | 3,000 | 5.75% | 2966.23 | 3016.32 |

| | Issuer | Offer Date | Low Initial Filing Price | High Initial Filing Price | Final Offer Price | First Trading Day Closing Price | Total Shares Offered Globally (000') | Three Month T Bill Rate | DJIA at Offer Date | DJIA at Red Herring Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 168 | Video Lottery Technolo | 07/24/91 | 11.50 | 13.00 | 14.00 | 18.00 | 2,850 | 5.75% | 2966.23 | 2944.77 |
| 169 | Genetic Therapy | 07/31/91 | 11.00 | 13.00 | 9.00 | 8.75 | 1,555 | 5.75% | 3024.82 | 2966.23 |
| 170 | Somatogen | 08/02/91 | 17.00 | 19.00 | 19.00 | 25.75 | 2,000 | 5.43% | 3006.26 | 2910.11 |
| 171 | Sanborn | 08/07/91 | 3.00 | 3.00 | 3.00 | 3.63 | 1,250 | 5.43% | 3026.61 | 2913.01 |
| 172 | Special Devices | 08/07/91 | 10.00 | 12.00 | 9.50 | 10.00 | 2,000 | 5.43% | 3026.61 | 2980.10 |
| 173 | Capital Bancorporation | 08/08/91 | 14.00 | 16.00 | 14.50 | 15.00 | 1,030 | 5.43% | 3013.86 | 3012.97 |
| 174 | Candy's Tortilla Factory | 08/09/91 | 2.50 | 3.00 | 3.00 | 3.25 | 1,000 | 5.43% | 2996.20 | 3000.45 |
| 175 | Community 1st Banksh | 08/13/91 | 10.00 | 12.00 | 10.75 | 11.50 | 1,700 | 5.43% | 3008.72 | 3017.67 |
| 176 | Fischer Imaging | 08/15/91 | 10.00 | 12.00 | 11.00 | 12.00 | 1,970 | 5.43% | 2998.43 | 2934.70 |
| 177 | Zebra Technologies | 08/15/91 | 12.00 | 14.00 | 15.50 | 18.25 | 2,840 | 5.43% | 2998.43 | 2980.77 |
| 178 | Saratoga Brands | 09/04/91 | 3.00 | 3.00 | 3.00 | 2.63 | 1,467 | 5.34% | 3008.50 | 2913.69 |
| 179 | MedAmicus | 09/06/91 | 3.25 | 3.25 | 3.25 | 4.25 | 1,100 | 5.34% | 3011.63 | 2913.69 |
| 180 | Artisoft | 09/20/91 | 11.50 | 13.50 | 16.00 | 20.75 | 5,000 | 5.34% | 3019.23 | 2989.04 |
| 181 | HoloPak Technologies | 09/20/91 | 12.00 | 14.00 | 16.00 | 18.00 | 1,000 | 5.34% | 3019.23 | 2989.04 |
| 182 | Sepracor | 09/20/91 | 8.00 | 9.00 | 10.00 | 15.50 | 4,000 | 5.34% | 3019.23 | 2983.90 |
| 183 | CellPro | 09/24/91 | 8.00 | 11.00 | 11.00 | 14.00 | 3,000 | 5.34% | 3029.07 | 2898.03 |
| 184 | MediVators | 09/25/91 | 3.50 | 4.00 | 3.50 | 3.50 | 1,500 | 5.34% | 3021.02 | 2985.69 |
| 185 | York Intl Corp | 10/01/91 | 21.00 | 23.00 | 23.00 | 24.13 | 10,700 | 5.10% | 3018.34 | 3007.83 |
| 186 | RP Scherer | 10/11/91 | 16.00 | 18.00 | 18.00 | 18.25 | 10,000 | 5.10% | 2983.68 | 3040.25 |
| 187 | US Robotics | 10/11/91 | 11.00 | 13.00 | 13.00 | 13.00 | 3,600 | 5.10% | 2983.68 | 3043.60 |
| 188 | Warnaco Group | 10/11/91 | 16.00 | 18.00 | 20.00 | 22.75 | 6,000 | 5.10% | 2983.68 | 3011.63 |
| 189 | Read-Rite | 10/18/91 | 11.00 | 13.00 | 11.50 | 12.63 | 4,429 | 5.10% | 3077.15 | 3008.50 |
| 190 | Noise Com | 10/21/91 | 4.00 | 4.00 | 4.00 | 4.75 | 1,000 | 5.10% | 3060.38 | 2946.33 |
| 191 | American BioMed | 10/22/91 | 5.00 | 5.00 | 5.00 | 6.25 | 800 | 5.10% | 3039.80 | 2913.69 |
| 192 | Mitek Surgical products | 10/25/91 | 12.00 | 14.00 | 16.00 | 24.75 | 900 | 5.10% | 3004.92 | 3007.16 |
| 193 | AutoCam | 10/29/91 | 9.00 | 11.00 | 10.00 | 13.00 | 800 | 5.10% | 3061.94 | 2898.03 |
| 194 | Sage Alerting Systems | 10/29/91 | 3.00 | 3.00 | 3.00 | 2.88 | 1,400 | 5.10% | 3061.94 | 2946.33 |
| 195 | Alteon | 11/01/91 | 12.00 | 14.00 | 15.00 | 28.75 | 3,000 | 4.54% | 3056.35 | 2942.75 |
| 196 | Marquette Electronics | 11/01/91 | 17.00 | 19.00 | 16.25 | 18.00 | 3,027 | 4.54% | 3056.35 | 3029.07 |
| 197 | Advanced Intl Sys | 11/06/91 | 10.00 | 12.00 | 13.00 | 17.50 | 2,300 | 4.54% | 3038.46 | 3016.77 |
| 198 | Athena Neurosciences | 11/07/91 | 10.00 | 12.00 | 12.00 | 17.00 | 4,500 | 4.54% | 3054.11 | 3016.77 |
| 199 | Amphenol | 11/08/91 | 13.50 | 15.50 | 9.25 | 9.25 | 17,300 | 4.54% | 3045.62 | 2968.02 |
| 200 | Wabash National | 11/08/91 | 12.00 | 14.00 | 14.00 | 17.63 | 2,700 | 4.54% | 3045.62 | 3006.04 |
| 201 | Bally Gaming Intl | 11/11/91 | 11.00 | 12.00 | 12.00 | 14.00 | 3,000 | 4.54% | 3042.26 | 3045.62 |
| 202 | Joy Technologies | 11/15/91 | 15.00 | 17.00 | 17.00 | 17.00 | 9,000 | 4.54% | 2943.20 | 3004.92 |
| 203 | Agricultural Minerals | 11/26/91 | 21.00 | 23.00 | 21.50 | 21.50 | 7,636 | 4.54% | 2916.14 | 2943.20 |
| 204 | Aramed | 11/27/91 | 20.00 | 20.00 | 20.00 | 20.00 | 2,500 | 4.54% | 2900.04 | 3041.37 |
| 205 | Conceptronic | 12/04/91 | 6.00 | 6.50 | 6.00 | 6.13 | 950 | 4.13% | 2911.67 | 2961.76 |
| 206 | Intervisual Books | 12/04/91 | 3.00 | 3.00 | 3.00 | 4.25 | 1,700 | 4.13% | 2911.67 | 3016.77 |
| 207 | Sam & Libby | 12/04/91 | 12.50 | 14.50 | 14.50 | 15.75 | 2,750 | 4.13% | 2911.67 | 3031.31 |
| 208 | Jansko | 12/06/91 | 2.00 | 3.00 | 3.00 | 3.75 | 1,750 | 4.13% | 2886.40 | 3054.11 |
| 209 | DNX | 12/11/91 | 13.00 | 15.00 | 13.00 | 12.50 | 2,500 | 4.13% | 2865.38 | 2911.67 |
| 210 | Vitesse Semiconductor | 12/11/91 | 8.00 | 9.00 | 9.00 | 10.25 | 3,200 | 4.13% | 2865.38 | 2929.56 |
| 211 | F&C Intl | 12/13/91 | 12.00 | 14.00 | 13.50 | 18.75 | 2,250 | 4.13% | 2914.36 | 2871.65 |
| 212 | QUALCOMM | 12/13/91 | 14.00 | 16.00 | 16.00 | 18.00 | 4,000 | 4.13% | 2914.36 | 2911.67 |
| 213 | Affymax | 12/17/91 | 16.00 | 18.00 | 20.00 | 24.75 | 4,000 | 4.13% | 2902.28 | 2900.04 |
| 214 | Genta | 12/17/91 | 10.00 | 12.00 | 10.00 | 10.00 | 2,500 | 4.13% | 2902.28 | 3045.62 |
| 215 | Fisher Scientific Intl | 12/18/91 | 15.00 | 18.00 | 14.50 | 14.13 | 8,500 | 4.13% | 2908.09 | 2889.09 |
| 216 | Syquest Technology | 12/18/91 | 8.00 | 10.00 | 10.50 | 12.75 | 2,800 | 4.13% | 2908.09 | 2972.72 |
| 217 | Semiconductor Pkg Mat | 12/20/91 | 5.00 | 5.00 | 5.00 | 5.13 | 1,135 | 4.13% | 2934.48 | 2886.40 |
| 218 | Amylin Pharmaceuticals | 01/17/92 | 8.00 | 10.00 | 14.00 | 20.75 | 4,000 | 3.88% | 3264.98 | 3204.83 |
| 219 | CardioPulmonics | 01/17/92 | 9.00 | 11.00 | 11.00 | 17.00 | 2,500 | 3.88% | 3264.98 | 2911.67 |
| 220 | Farrel | 01/17/92 | 11.00 | 13.00 | 9.50 | 9.75 | 2,000 | 3.88% | 3264.98 | 3185.60 |
| 221 | Menley & James | 01/21/92 | 12.00 | 14.00 | 13.00 | 13.75 | 2,000 | 3.88% | 3223.39 | 3172.41 |
| 222 | Protein Polymer Techno | 01/21/92 | 5.00 | 7.00 | 6.50 | 6.75 | 1,450 | 3.88% | 3223.39 | 3258.50 |
| 223 | Spectranetics | 01/21/92 | 11.00 | 13.00 | 13.50 | 16.75 | 2,500 | 3.88% | 3223.39 | 3199.46 |
| 224 | MedSonic | 01/23/92 | 6.00 | 6.00 | 6.50 | 6.50 | 1,600 | 3.88% | 3226.74 | 3201.48 |

| | Issuer | Offer Date | Low Initial Filing Price | High Initial Filing Price | Final Offer Price | First Trading Day Closing Price | Total Shares Offered Globally (000') | Three Month T Bill Rate | DJIA at Offer Date | DJIA at Red Herring Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 225 | Sphinx Pharmaceuticals | 01/23/92 | 10.00 | 12.00 | 15.00 | 15.00 | 5,000 | 3.88% | 3226.74 | 3201.48 |
| 226 | Corvas Intl | 01/30/92 | 10.00 | 12.00 | 12.00 | 12.00 | 3,000 | 3.88% | 3244.86 | 3199.46 |
| 227 | ElectroCom Automation | 01/30/92 | 14.00 | 16.00 | 16.00 | 16.75 | 11,500 | 3.88% | 3244.86 | 3255.81 |
| 228 | Zynaxis | 01/30/92 | 7.00 | 8.00 | 9.00 | 10.25 | 2,500 | 3.88% | 3244.86 | 3209.30 |
| 229 | Scotts | 01/31/92 | 15.00 | 18.00 | 19.00 | 22.25 | 12,500 | 3.88% | 3223.39 | 3199.46 |
| 230 | Univax Biologics | 02/04/92 | 10.00 | 12.00 | 12.00 | 13.13 | 4,000 | 3.97% | 3272.81 | 3246.20 |
| 231 | EconScience | 02/05/92 | 8.00 | 10.00 | 11.00 | 10.75 | 2,600 | 3.97% | 3257.60 | 2934.48 |
| 232 | Defense Software & Sy | 02/11/92 | 5.00 | 5.00 | 6.00 | 10.13 | 1,000 | 3.97% | 3251.57 | 3225.40 |
| 233 | Intl Jensen | 02/12/92 | 9.50 | 11.50 | 11.50 | 13.63 | 1,650 | 3.97% | 3276.83 | 3223.39 |
| 234 | Agridyne Technologies | 02/14/92 | 10.50 | 12.50 | 10.00 | 9.88 | 1,750 | 3.97% | 3245.97 | 3226.74 |
| 235 | Document Technologie | 02/14/92 | 6.00 | 7.00 | 6.00 | 5.13 | 750 | 3.97% | 3245.97 | 3276.83 |
| 236 | Chemtrak | 02/19/92 | 11.00 | 13.00 | 13.00 | 12.75 | 2,000 | 3.97% | 3230.32 | 3224.96 |
| 237 | Coleman | 02/26/92 | 18.00 | 20.00 | 19.50 | 25.13 | 4,250 | 3.97% | 3283.32 | 3185.60 |
| 238 | Forstmann | 02/26/92 | 10.00 | 12.00 | 9.00 | 9.00 | 2,750 | 3.97% | 3283.32 | 3240.61 |
| 239 | I-Stat | 02/26/92 | 15.00 | 17.00 | 18.50 | 18.25 | 3,000 | 3.97% | 3283.32 | 3280.19 |
| 240 | Synopsys | 02/26/92 | 13.00 | 15.00 | 18.00 | 31.50 | 2,000 | 3.97% | 3283.32 | 3264.98 |
| 241 | Toastmaster | 03/03/92 | 15.00 | 17.00 | 15.00 | 15.00 | 2,875 | 4.14% | 3290.25 | 3257.83 |
| 242 | Endosonics | 03/04/92 | 11.00 | 13.00 | 15.00 | 16.50 | 2,750 | 4.14% | 3268.56 | 3257.83 |
| 243 | Opta Food Ingredients | 03/04/92 | 12.00 | 14.00 | 12.00 | 12.00 | 1,700 | 4.14% | 3268.56 | 3255.81 |
| 244 | Biotime | 03/05/92 | 7.00 | 9.00 | 8.00 | 12.00 | 630 | 4.14% | 3241.51 | 2908.09 |
| 245 | Gibraltar Packaging Gp | 03/05/92 | 8.00 | 10.00 | 10.00 | 10.00 | 1,333 | 4.14% | 3241.51 | 3245.97 |
| 246 | PolyMedica Ind. | 03/05/92 | 11.00 | 13.00 | 13.00 | 13.00 | 3,000 | 4.14% | 3241.51 | 3224.73 |
| 247 | Applied Laser Sys | 03/10/92 | 3.00 | 3.00 | 3.00 | 3.25 | 2,400 | 4.14% | 3230.99 | 3172.41 |
| 248 | Day Runner | 03/11/92 | 12.00 | 14.00 | 15.00 | 17.75 | 1,575 | 4.14% | 3208.63 | 3290.25 |
| 249 | Valassis Communicatio | 03/11/92 | 20.00 | 23.00 | 17.00 | 16.75 | 22,100 | 4.14% | 3208.63 | 3223.39 |
| 250 | Pet Products | 03/12/92 | 5.00 | 5.00 | 4.75 | 6.50 | 900 | 4.14% | 3208.63 | 2865.38 |
| 251 | Cellcor | 03/13/92 | 11.00 | 13.00 | 11.00 | 11.50 | 2,000 | 4.14% | 3235.91 | 3215.12 |
| 252 | Glacier Water Sve. | 03/13/92 | 10.00 | 13.00 | 11.00 | 10.75 | 2,000 | 4.14% | 3235.91 | 3241.51 |
| 253 | health o meter products | 03/17/92 | 13.00 | 15.00 | 14.00 | 14.25 | 2,500 | 4.14% | 3256.04 | 3230.99 |
| 254 | SciClone Phar. | 03/17/92 | 6.00 | 8.00 | 7.25 | 8.75 | 3,000 | 4.14% | 3256.04 | 3235.91 |
| 255 | Burlingtong Ind Equity | 03/19/92 | 14.00 | 16.00 | 14.00 | 14.00 | 44,930 | 4.14% | 3261.40 | 3256.04 |
| 256 | Telios Phar. | 03/19/92 | 10.00 | 12.00 | 8.00 | 8.00 | 2,500 | 4.14% | 3261.40 | 3245.08 |
| 257 | Triconex | 03/19/92 | 12.00 | 14.00 | 13.00 | 16.25 | 2,000 | 4.14% | 3261.40 | 3101.52 |
| 258 | Protocol Sys | 03/24/92 | 9.00 | 11.00 | 11.00 | 11.75 | 2,750 | 4.14% | 3260.96 | 3272.14 |
| 259 | Coltec Ind | 03/25/92 | 13.00 | 15.00 | 15.00 | 18.00 | 38,500 | 4.14% | 3259.39 | 3276.39 |
| 260 | CytoTherapeutics | 03/25/92 | 12.00 | 14.00 | 11.00 | 9.75 | 2,250 | 4.14% | 3259.39 | 3245.97 |
| 261 | Satellite Tech. | 03/25/92 | 8.00 | 10.00 | 10.00 | 10.13 | 1,625 | 4.14% | 3259.39 | 3245.97 |
| 262 | Vital Living Products | 03/25/92 | 3.25 | 3.25 | 3.25 | 3.38 | 1,321 | 4.14% | 3259.39 | 3221.60 |
| 263 | Avecor Cardiovascular | 03/26/92 | 4.00 | 5.50 | 5.50 | 7.50 | 1,255 | 4.14% | 3267.67 | 3261.40 |
| 264 | Natural Earth Tech. | 03/26/92 | 5.00 | 5.00 | 5.00 | 5.25 | 1,000 | 4.14% | 3267.67 | 3223.39 |
| 265 | ICU Medical | 03/31/92 | 11.00 | 13.00 | 11.00 | 10.38 | 1,300 | 4.14% | 3235.47 | 3276.39 |
| 266 | Sybron Chemical Ind. | 03/31/92 | 23.00 | 25.00 | 20.00 | 20.00 | 1,784 | 4.14% | 3235.47 | 3267.67 |
| 267 | Mohawk Ind | 04/01/92 | 14.00 | 16.00 | 15.00 | 15.38 | 2,700 | 3.72% | 3249.33 | 3224.96 |
| 268 | Seragen | 04/01/92 | 17.00 | 20.00 | 12.00 | 12.25 | 3,000 | 3.72% | 3249.33 | 3231.44 |
| 269 | NCI Bldg Sys | 04/03/92 | 9.00 | 11.00 | 9.50 | 9.88 | 1,750 | 3.72% | 3249.11 | 3272.14 |
| 270 | ERO | 04/07/92 | 14.00 | 16.00 | 16.50 | 16.75 | 3,500 | 3.72% | 3213.55 | 3235.24 |
| 271 | VideoTelecom | 04/07/92 | 10.00 | 12.00 | 11.50 | 12.50 | 2,400 | 3.72% | 3213.55 | 3267.67 |
| 272 | Bell Sports | 04/09/92 | 11.50 | 13.50 | 15.00 | 17.75 | 3,000 | 3.72% | 3224.96 | 3280.64 |
| 273 | Simula | 04/13/92 | 5.00 | 5.00 | 5.00 | 5.00 | 1,000 | 3.72% | 3269.90 | 3221.60 |
| 274 | Affinity Biotech | 04/14/92 | 7.50 | 8.50 | 6.00 | 6.00 | 2,000 | 3.72% | 3306.13 | 3269.45 |
| 275 | Kopin | 04/15/92 | 11.00 | 14.00 | 10.00 | 10.00 | 1,500 | 3.72% | 3353.76 | 3280.64 |
| 276 | AGCO | 04/16/92 | 16.00 | 18.00 | 14.00 | 14.00 | 4,500 | 3.72% | 3366.50 | 3234.12 |
| 277 | Morningstar Group | 04/24/92 | 14.00 | 16.00 | 11.00 | 10.50 | 6,215 | 3.72% | 3324.46 | 3230.32 |
| 278 | Natural Child Care | 04/28/92 | 3.25 | 3.25 | 3.25 | 3.25 | 1,500 | 3.72% | 3307.92 | 3232.78 |
| 279 | Galey & Lord | 04/30/92 | 13.00 | 15.00 | 10.00 | 10.00 | 2,900 | 3.72% | 3359.12 | 3304.56 |
| 280 | Metricom | 05/01/92 | 8.00 | 10.00 | 6.00 | 6.00 | 1,500 | 3.64% | 3336.09 | 3269.90 |
| 281 | Lida | 05/06/92 | 15.00 | 17.00 | 11.50 | 11.38 | 2,000 | 3.64% | 3369.41 | 3359.12 |

| | Issuer | Offer Date | Low Initial Filing Price | High Initial Filing Price | Final Offer Price | First Trading Day Closing Price | Total Shares Offered Globally (000') | Three Month T Bill Rate | DJIA at Offer Date | DJIA at Red Herring Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 282 | Stac Electronics | 05/07/92 | 12.00 | 14.00 | 12.00 | 12.50 | 3,000 | 3.64% | 3363.37 | 3353.76 |
| 283 | Sybron | 05/07/92 | 14.00 | 16.00 | 14.00 | 14.13 | 7,907 | 3.64% | 3363.37 | 3255.37 |
| 284 | Valence Tech. | 05/07/92 | 6.00 | 8.00 | 8.00 | 8.75 | 3,600 | 3.64% | 3363.37 | 3359.12 |
| 285 | Dyersburg | 05/12/92 | 12.00 | 14.00 | 9.00 | 8.88 | 4,600 | 3.64% | 3385.12 | 3363.37 |
| 286 | Bitwise Designs | 05/13/92 | 3.50 | 4.50 | 3.50 | 3.75 | 1,000 | 3.64% | 3391.98 | 3369.41 |
| 287 | TheraTech | 05/13/92 | 11.00 | 12.50 | 7.50 | 6.25 | 1,250 | 3.64% | 3391.98 | 3235.24 |
| 288 | Biocircuits | 05/14/92 | 8.00 | 10.00 | 5.00 | 4.75 | 2,000 | 3.64% | 3368.88 | 3385.12 |
| 289 | Enzymatics | 05/14/92 | 10.00 | 12.00 | 7.00 | 7.00 | 1,700 | 3.64% | 3368.88 | 3254.25 |
| 290 | SuperMac Tech. | 05/15/92 | 10.00 | 12.00 | 9.00 | 10.25 | 2,000 | 3.64% | 3353.09 | 3397.58 |
| 291 | Holson Burnes Grp. | 05/20/92 | 14.00 | 16.00 | 14.00 | 14.38 | 2,200 | 3.64% | 3393.84 | 3333.18 |
| 292 | Optical Data Sys | 05/21/92 | 12.00 | 14.00 | 9.00 | 9.00 | 1,900 | 3.64% | 3378.71 | 3249.33 |
| 293 | Datawatch | 05/28/92 | 5.00 | 5.00 | 5.00 | 4.75 | 1,000 | 3.64% | 3398.43 | 3256.04 |
| 294 | PerSeptive Biosystems | 05/29/92 | 11.00 | 13.00 | 7.00 | 8.88 | 2,500 | 3.64% | 3396.88 | 3393.84 |
| 295 | Steris | 06/01/92 | 13.00 | 14.00 | 7.00 | 8.25 | 2,000 | 3.75% | 3413.21 | 3397.58 |
| 296 | Rival | 06/02/92 | 14.00 | 16.00 | 10.50 | 10.50 | 2,200 | 3.75% | 3396.10 | 3396.88 |
| 297 | Salem Sportswear | 06/03/92 | 14.00 | 17.00 | 12.50 | 12.50 | 2,750 | 3.75% | 3406.99 | 3249.11 |
| 298 | Netframe Sys | 06/04/92 | 10.00 | 12.00 | 9.00 | 9.50 | 3,000 | 3.75% | 3399.73 | 3366.50 |
| 299 | Kronos | 06/05/92 | 12.00 | 14.00 | 12.00 | 12.25 | 1,500 | 3.75% | 3398.69 | 3396.88 |
| 300 | Arrow Intl | 06/09/92 | 21.00 | 24.00 | 18.00 | 18.13 | 2,500 | 3.75% | 3369.92 | 3269.90 |
| 301 | Intramed Lab. | 06/09/92 | 8.00 | 10.00 | 5.50 | 5.25 | 1,200 | 3.75% | 3369.92 | 3406.99 |
| 302 | General Instr. | 06/10/92 | 16.00 | 19.00 | 15.00 | 15.00 | 22,000 | 3.75% | 3343.22 | 3249.11 |
| 303 | Columbia Bkg Sys | 06/16/92 | 8.00 | 10.00 | 8.88 | 9.25 | 550 | 3.75% | 3329.49 | 3364.21 |
| 304 | Riverwood Intl | 06/17/92 | 14.00 | 16.00 | 14.25 | 14.25 | 11,000 | 3.75% | 3287.76 | 3354.90 |
| 305 | Cone Mills | 06/18/92 | 12.00 | 14.00 | 10.00 | 10.00 | 6,000 | 3.75% | 3274.12 | 3287.76 |
| 306 | CrossComm | 06/18/92 | 10.00 | 12.00 | 11.00 | 11.50 | 2,660 | 3.75% | 3274.12 | 3354.36 |
| 307 | Tapistron Intl | 06/24/92 | 6.50 | 7.50 | 6.75 | 6.25 | 2,250 | 3.75% | 3290.70 | 3369.41 |
| 308 | Cholestech | 06/26/92 | 7.00 | 9.00 | 5.00 | 5.38 | 2,000 | 3.75% | 3282.41 | 3404.14 |
| 309 | Starbucks Coffee | 06/26/92 | 14.00 | 16.00 | 17.00 | 21.50 | 2,100 | 3.75% | 3282.41 | 3404.14 |
| 310 | Ultramar | 06/26/92 | 18.00 | 21.00 | 15.00 | 15.00 | 33,000 | 3.75% | 3282.41 | 3404.14 |
| 311 | MicroTouch Sys | 06/30/92 | 13.00 | 15.00 | 13.50 | 15.25 | 1,350 | 3.75% | 3318.52 | 3391.98 |
| 312 | British Bio-Tech. | 07/01/92 | 15.80 | 17.60 | 16.15 | 16.00 | 3,529 | 3.69% | 3354.10 | 3343.22 |
| 313 | Cantab Phar. | 07/01/92 | 10.00 | 12.00 | 10.00 | 10.00 | 1,000 | 3.69% | 3354.10 | 3343.22 |
| 314 | Rexnord | 07/01/92 | 21.00 | 23.00 | 17.00 | 17.00 | 9,200 | 3.69% | 3354.10 | 3343.22 |
| 315 | Matritech | 07/09/92 | 8.00 | 10.00 | 5.00 | 5.25 | 1,150 | 3.69% | 3324.08 | 3285.35 |
| 316 | Argus Phar. | 07/10/92 | 12.00 | 14.00 | 7.00 | 7.25 | 1,700 | 3.69% | 3330.56 | 3280.80 |
| 317 | Encore Wire | 07/16/92 | 11.00 | 13.00 | 9.00 | 9.38 | 1,500 | 3.69% | 3361.63 | 3282.41 |
| 318 | Medrad | 07/16/92 | 13.00 | 15.00 | 12.00 | 16.00 | 1,000 | 3.69% | 3361.63 | 3290.70 |
| 319 | Zoll Medical | 07/16/92 | 10.00 | 12.00 | 10.00 | 13.50 | 2,100 | 3.69% | 3361.63 | 3353.09 |
| 320 | Ampex | 07/17/92 | 12.00 | 14.00 | 6.00 | 6.00 | 3,000 | 3.69% | 3331.64 | 3319.86 |
| 321 | StrataCom | 07/21/92 | 7.50 | 9.00 | 7.00 | 7.00 | 2,500 | 3.69% | 3308.41 | 3354.10 |
| 322 | First Pacific Networks | 07/22/92 | 9.00 | 11.00 | 9.00 | 9.25 | 5,000 | 3.69% | 3277.61 | 3330.29 |
| 323 | GTECH Holdings | 07/22/92 | 17.00 | 20.00 | 17.00 | 18.00 | 8,500 | 3.69% | 3277.61 | 3330.29 |
| 324 | Wellcome | 07/27/92 | 17.93 | 17.93 | 15.25 | 15.25 | 270,000 | 3.69% | 3282.20 | 3295.17 |
| 325 | Hi-Tech Pharm. | 08/03/92 | 6.00 | 7.00 | 6.00 | 6.25 | 1,000 | 3.21% | 3395.40 | 3337.31 |
| 326 | Envirogen | 08/11/92 | 7.00 | 8.00 | 7.00 | 6.75 | 1,230 | 3.21% | 3331.10 | 3308.41 |
| 327 | Bestop | 08/13/92 | 11.00 | 13.00 | 9.00 | 8.75 | 925 | 3.21% | 3313.27 | 3290.04 |
| 328 | Computervision | 08/14/92 | 18.00 | 20.00 | 12.00 | 12.00 | 25,000 | 3.21% | 3328.94 | 3285.71 |
| 329 | Alden Press | 08/18/92 | 11.50 | 13.50 | 9.00 | 8.75 | 2,500 | 3.21% | 3329.48 | 3334.07 |
| 330 | Danskin | 08/19/92 | 12.00 | 14.00 | 13.00 | 12.13 | 3,000 | 3.21% | 3307.06 | 3379.19 |
| 331 | Lifequest Med. | 08/20/92 | 11.00 | 13.00 | 10.50 | 10.63 | 1,500 | 3.21% | 3304.89 | 3395.40 |
| 332 | Swing-N-Slide | 08/28/92 | 12.00 | 14.00 | 11.00 | 10.50 | 2,600 | 3.21% | 3267.61 | 3337.58 |
| 333 | R2 Medical Sys | 09/01/92 | 5.00 | 6.00 | 4.75 | 5.25 | 1,000 | 2.63% | 3266.26 | 3331.10 |
| 334 | Intelligent Surgical Lase | 09/11/92 | 9.00 | 11.00 | 8.00 | 8.50 | 475 | 2.63% | 3306.25 | 3254.10 |
| 335 | Netrix | 09/22/92 | 10.00 | 12.00 | 12.00 | 13.25 | 2,750 | 2.63% | 3280.85 | 3290.31 |
| 336 | BLADEX | 09/24/92 | 22.00 | 25.00 | 22.00 | 22.00 | 4,000 | 2.63% | 3287.87 | 3281.93 |
| 337 | Caraustar Ind. | 10/01/92 | 16.00 | 18.00 | 15.00 | 15.13 | 9,655 | 2.99% | 3254.37 | 3305.16 |

| | Issuer | Offer Date | Low Initial Filing Price | High Initial Filing Price | Final Offer Price | First Trading Day Closing Price | Total Shares Offered Globally (000') | Three Month T Bill Rate | DJIA at Offer Date | DJIA at Red Herring Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 338 | Just Toys | 10/01/92 | 10.00 | 12.00 | 10.50 | 12.25 | 1,100 | 2.99% | 3254.37 | 3328.94 |
| 339 | Nu-Kote Hldg. | 10/01/92 | 15.00 | 15.00 | 12.00 | 12.13 | 3,700 | 2.99% | 3254.37 | 3306.25 |
| 340 | Electronics for Imaging | 10/02/92 | 10.00 | 12.00 | 12.75 | 15.00 | 3,000 | 2.99% | 3200.61 | 3306.79 |
| 341 | Microtek Med. | 10/06/92 | 11.00 | 13.00 | 10.00 | 10.00 | 1,415 | 2.99% | 3178.19 | 3319.21 |
| 342 | Data Race | 10/07/92 | 11.00 | 13.00 | 13.00 | 14.75 | 1,800 | 2.99% | 3152.25 | 3315.70 |
| 343 | Brilliance China Automo | 10/09/92 | 14.00 | 16.00 | 16.00 | 20.13 | 5,000 | 2.99% | 3136.58 | 3232.22 |
| 344 | Todhunter Intl | 10/13/92 | 8.00 | 10.00 | 6.00 | 6.13 | 1,500 | 2.99% | 3201.42 | 3278.69 |
| 345 | Copley Phar. | 10/14/92 | 14.00 | 16.00 | 19.00 | 23.50 | 2,200 | 2.99% | 3195.48 | 3287.87 |
| 346 | Alpha-Beta Tech. | 10/16/92 | 14.00 | 16.00 | 8.00 | 9.25 | 2,000 | 2.99% | 3174.41 | 3276.26 |
| 347 | Kemet | 10/21/92 | 12.00 | 14.00 | 10.00 | 10.00 | 4,000 | 2.99% | 3187.10 | 3200.61 |
| 348 | Sterling Bancshares Inc | 10/22/92 | 11.00 | 13.00 | 12.00 | 13.00 | 900 | 2.99% | 3200.88 | 3152.25 |
| 349 | Minerals Tech. | 10/23/92 | 21.00 | 23.00 | 16.00 | 17.00 | 13,000 | 2.99% | 3207.64 | 3179.00 |
| 350 | Microtest | 10/30/92 | 11.00 | 13.00 | 14.50 | 17.00 | 2,300 | 2.99% | 3226.28 | 3174.41 |
| 351 | Cypros Pharm. | 11/04/92 | 6.30 | 6.30 | 6.30 | 8.00 | 1,000 | 3.35% | 3223.04 | 3136.58 |
| 352 | Zoltek Co | 11/06/92 | 5.00 | 7.00 | 4.00 | 4.00 | 1,100 | 3.35% | 3240.06 | 3174.41 |
| 353 | SatCon Tech. | 11/12/92 | 5.00 | 5.00 | 5.00 | 4.50 | 1,500 | 3.35% | 3239.79 | 3327.32 |
| 354 | Ligand Pharm. | 11/18/92 | 10.00 | 12.00 | 11.00 | 12.25 | 3,750 | 3.35% | 3207.37 | 3327.32 |
| 355 | Soricon | 11/19/92 | 4.50 | 5.50 | 5.00 | 4.75 | 800 | 3.35% | 3209.53 | 3262.21 |
| 356 | USA Classic Inc. | 11/20/92 | 10.00 | 12.00 | 13.00 | 15.25 | 2,700 | 3.35% | 3227.36 | 3262.21 |
| 357 | NetWorth | 11/25/92 | 14.00 | 16.00 | 16.00 | 32.00 | 1,100 | 3.35% | 3266.26 | 3136.58 |
| 358 | Chart Ind. | 12/03/92 | 11.00 | 13.00 | 11.50 | 13.38 | 3,670 | 3.12% | 3276.53 | 3266.26 |
| 359 | Sellectek | 12/10/92 | 6.00 | 8.00 | 4.00 | 4.00 | 1,250 | 3.12% | 3312.19 | 3227.36 |
| 360 | Vision-Sciences | 12/15/92 | 7.00 | 9.00 | 9.00 | 12.00 | 2,550 | 3.12% | 3284.36 | 3266.26 |
| 361 | Syratech Corp | 12/16/92 | 14.00 | 16.00 | 17.00 | 18.75 | 2,200 | 3.12% | 3255.18 | 3282.20 |
| 362 | Trident Microsystems | 12/16/92 | 12.50 | 14.50 | 17.00 | 16.00 | 3,000 | 3.12% | 3255.18 | 3282.20 |
| 363 | MicroCarb | 12/17/92 | 6.00 | 6.00 | 6.00 | 7.00 | 1,200 | 3.12% | 3269.23 | 3136.58 |
| 364 | Palomar Med. Tech. | 12/18/92 | 3.33 | 4.00 | 4.00 | 4.00 | 1,650 | 3.12% | 3313.27 | 3282.20 |
| 365 | Ultralife Batteries Inc. | 12/23/92 | 7.00 | 9.00 | 9.75 | 13.25 | 1,750 | 3.12% | 3313.54 | 3276.53 |
| 366 | Rhone-Poulenc | 01/26/93 | 25.00 | 25.00 | 23.49 | 23.50 | 24,000 | 2.91% | 3298.95 | 3305.16 |
| 367 | BioSurface Tech. | 01/27/93 | 10.00 | 12.00 | 12.00 | 12.00 | 2,500 | 2.91% | 3291.39 | 3268.96 |
| 368 | CoCensys | 01/29/93 | 11.00 | 13.00 | 9.00 | 8.75 | 2,500 | 2.91% | 3310.03 | 3262.75 |
| 369 | Rocky Shoes & Boots | 02/03/93 | 9.00 | 10.00 | 10.00 | 12.00 | 1,650 | 2.99% | 3373.79 | 3263.56 |
| 370 | Hemagen Diagnostics | 02/04/93 | 5.00 | 5.00 | 5.00 | 6.00 | 1,000 | 2.99% | 3416.74 | 3251.67 |
| 371 | Proxima | 02/04/93 | 11.00 | 13.00 | 13.00 | 15.25 | 2,000 | 2.99% | 3416.74 | 3267.88 |
| 372 | Molecular Dynamics | 02/05/93 | 11.00 | 13.00 | 11.00 | 16.13 | 2,132 | 2.99% | 3442.14 | 3333.26 |
| 373 | BioSafety Sys | 02/11/93 | 6.00 | 7.00 | 6.00 | 6.25 | 600 | 2.99% | 3422.69 | 3253.02 |
| 374 | IEC Electronics | 02/12/93 | 11.00 | 13.00 | 13.00 | 13.25 | 2,500 | 2.99% | 3392.43 | 3256.81 |
| 375 | Universal Electronics | 02/12/93 | 10.00 | 12.00 | 13.00 | 17.00 | 2,400 | 2.99% | 3392.43 | 3256.81 |
| 376 | Chic By H.I.S. | 02/18/93 | 10.00 | 12.00 | 11.50 | 13.25 | 6,000 | 2.99% | 3302.19 | 3306.25 |
| 377 | Boca Research | 02/25/93 | 9.00 | 11.00 | 10.00 | 9.75 | 3,000 | 2.99% | 3365.14 | 3442.14 |
| 378 | Winston Furniture | 02/25/93 | 12.00 | 14.00 | 16.00 | 15.38 | 1,950 | 2.99% | 3365.14 | 3442.14 |
| 379 | Recovery Engrg. | 03/04/93 | 7.00 | 7.00 | 7.00 | 8.50 | 575 | 2.96% | 3398.91 | 3256.81 |
| 380 | ReSound | 03/04/93 | 8.00 | 10.00 | 8.50 | 10.88 | 2,500 | 2.96% | 3398.91 | 3356.50 |
| 381 | M-Systems Flash Disk | 03/04/93 | 3.00 | 4.00 | 4.00 | 6.00 | 1,150 | 2.96% | 3398.91 | 3309.49 |
| 382 | S3 | 03/05/93 | 11.00 | 13.00 | 15.00 | 19.75 | 2,000 | 2.96% | 3404.58 | 3309.49 |
| 383 | US Can Corp | 03/08/93 | 12.00 | 15.00 | 12.00 | 12.00 | 5,550 | 2.96% | 3469.42 | 3302.19 |
| 384 | Community Health Com | 03/09/93 | 10.00 | 12.00 | 10.00 | 10.00 | 2,000 | 2.96% | 3472.12 | 3322.18 |
| 385 | Hypermedia Communic | 03/09/93 | 4.50 | 5.50 | 5.00 | 5.00 | 1,400 | 2.96% | 3472.12 | 3322.18 |
| 386 | Superconductor Tech. | 03/09/93 | 10.00 | 12.00 | 10.00 | 10.50 | 1,500 | 2.96% | 3472.12 | 3365.14 |
| 387 | Southern Energy Home | 03/12/93 | 11.00 | 13.00 | 13.00 | 15.50 | 2,075 | 2.96% | 3427.82 | 3342.99 |
| 388 | Aseco | 03/16/93 | 8.50 | 10.00 | 9.50 | 10.25 | 1,500 | 2.96% | 3442.95 | 3370.81 |
| 389 | McGaw | 03/19/93 | 10.50 | 12.50 | 8.00 | 8.13 | 6,000 | 2.96% | 3471.58 | 3355.41 |
| 390 | Microchip Tech. | 03/19/93 | 11.00 | 13.00 | 13.00 | 14.88 | 1,500 | 2.96% | 3471.58 | 3355.41 |
| 391 | Tricord Sys | 03/19/93 | 8.00 | 9.00 | 11.00 | 11.00 | 3,000 | 2.96% | 3471.58 | 3355.41 |

| | Issuer | Offer Date | Low Initial Filing Price | High Initial Filing Price | Final Offer Price | First Trading Day Closing Price | Total Shares Offered Globally (000') | Three Month T Bill Rate | DJIA at Offer Date | DJIA at Red Herring Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 392 | Magal Security Sys | 03/23/93 | 6.50 | 8.50 | 8.75 | 10.88 | 1,200 | 2.96% | 3461.86 | 3404.04 |
| 393 | Chico's FAS | 03/24/93 | 12.00 | 14.00 | 14.00 | 17.50 | 1,400 | 2.96% | 3445.38 | 3398.91 |
| 394 | Intl Canine Genetics | 03/24/93 | 7.00 | 7.00 | 7.00 | 7.38 | 715 | 2.96% | 3445.38 | 3398.91 |
| 395 | Zonagen | 03/25/93 | 6.00 | 7.00 | 5.50 | 5.75 | 1,350 | 2.96% | 3461.32 | 3404.58 |
| 396 | Gilat Satellite Networks | 03/26/93 | 9.00 | 11.00 | 12.00 | 14.63 | 2,301 | 2.96% | 3439.98 | 3469.42 |
| 397 | Magna-Lab | 03/30/93 | 6.00 | 6.00 | 6.00 | 5.50 | 1,000 | 2.96% | 3457.27 | 3302.19 |
| 398 | Parallan Computer | 03/30/93 | 10.00 | 12.00 | 12.00 | 12.00 | 2,250 | 2.96% | 3457.27 | 3478.34 |
| 399 | Liberty Tech. | 03/31/93 | 9.00 | 11.00 | 9.00 | 9.13 | 1,800 | 2.96% | 3435.11 | 3457.00 |
| 400 | BancFirst | 04/01/93 | 14.00 | 16.00 | 15.00 | 17.00 | 1,073 | 2.94% | 3439.44 | 3302.19 |
| 401 | Fossil | 04/08/93 | 7.50 | 9.00 | 7.50 | 8.25 | 2,400 | 2.94% | 3396.48 | 3465.64 |
| 402 | Starter | 04/08/93 | 16.00 | 18.00 | 21.50 | 25.13 | 7,750 | 2.94% | 3396.48 | 3465.64 |
| 403 | Central Virginia Banksh | 04/14/93 | 11.00 | 13.00 | 12.75 | 14.50 | 325 | 2.94% | 3455.64 | 3445.38 |
| 404 | Orthopedic Tech. | 04/14/93 | 5.00 | 6.00 | 6.00 | 6.13 | 1,500 | 2.94% | 3455.64 | 3445.38 |
| 405 | Safety 1st | 04/14/93 | 11.00 | 13.00 | 12.00 | 12.38 | 2,000 | 2.94% | 3455.64 | 3398.91 |
| 406 | Sanmina | 04/14/93 | 11.00 | 13.00 | 10.00 | 10.75 | 2,300 | 2.94% | 3455.64 | 3445.38 |
| 407 | Commander Aircraft | 04/19/93 | 7.00 | 9.00 | 8.75 | 9.50 | 1,250 | 2.94% | 3466.99 | 3455.10 |
| 408 | Martin Color-Fi | 04/21/93 | 11.00 | 13.00 | 11.00 | 10.25 | 1,400 | 2.94% | 3439.44 | 3469.44 |
| 409 | West Coast Bancorp In | 04/22/93 | 9.50 | 11.50 | 10.50 | 10.75 | 600 | 2.94% | 3429.17 | 3370.81 |
| 410 | Harmony Brook | 04/23/93 | 3.00 | 3.00 | 3.00 | 2.75 | 1,667 | 2.94% | 3413.77 | 3471.58 |
| 411 | Action Performance Co. | 04/27/93 | 4.00 | 6.00 | 5.50 | 6.25 | 1,250 | 2.94% | 3415.93 | 3397.02 |
| 412 | Geon Co | 04/29/93 | 21.00 | 24.00 | 18.00 | 18.75 | 13,000 | 2.94% | 3425.12 | 3428.09 |
| 413 | Jabil Circuit | 04/29/93 | 10.00 | 12.00 | 7.00 | 7.25 | 2,500 | 2.94% | 3425.12 | 3428.09 |
| 414 | California Quartz | 05/06/93 | 4.00 | 4.00 | 4.00 | 6.00 | 805 | 3.11% | 3441.90 | 3355.41 |
| 415 | Catalyst Semiconductor | 05/11/93 | 9.00 | 11.00 | 11.00 | 13.50 | 3,000 | 3.11% | 3468.75 | 3439.44 |
| 416 | Telor Ophthalmic | 05/11/93 | 12.00 | 14.00 | 8.00 | 8.75 | 2,500 | 3.11% | 3468.75 | 3439.44 |
| 417 | Quad Sys | 05/12/93 | 7.00 | 8.50 | 7.00 | 7.25 | 2,000 | 3.11% | 3482.31 | 3429.17 |
| 418 | Industrie Natuzzi | 05/13/93 | 12.50 | 14.50 | 15.00 | 15.75 | 8,400 | 3.11% | 3447.99 | 3413.77 |
| 419 | Megatest | 05/18/93 | 10.00 | 12.00 | 12.00 | 12.50 | 2,600 | 3.11% | 3444.39 | 3413.50 |
| 420 | Supreme Intl | 05/21/93 | 10.00 | 12.00 | 11.50 | 11.75 | 1,200 | 3.11% | 3492.83 | 3446.46 |
| 421 | Madeco | 05/28/93 | 14.80 | 14.80 | 15.00 | 15.13 | 3,938 | 3.11% | 3554.83 | 3523.28 |
| 422 | Interlink Electronics | 06/07/93 | 5.50 | 6.50 | 5.50 | 5.50 | 1,350 | 3.03% | 3532.13 | 3449.93 |
| 423 | Aldila | 06/08/93 | 10.00 | 12.00 | 14.00 | 21.25 | 2,300 | 3.03% | 3510.55 | 3444.39 |
| 424 | American Safety Razor | 06/08/93 | 15.00 | 17.00 | 12.00 | 12.00 | 5,000 | 3.03% | 3510.55 | 3444.39 |
| 425 | Ellett Brothers | 06/09/93 | 10.00 | 12.00 | 9.00 | 9.25 | 1,225 | 3.03% | 3511.93 | 3500.03 |
| 426 | Banco de Galicia,Bueno | 06/11/93 | 22.00 | 22.00 | 21.75 | 22.00 | 3,000 | 3.03% | 3505.01 | 3492.83 |
| 427 | Norwood Promotional P | 06/16/93 | 10.00 | 12.00 | 11.00 | 11.50 | 1,500 | 3.03% | 3511.65 | 3443.01 |
| 428 | Intl Imaging | 06/17/93 | 12.00 | 14.00 | 14.00 | 16.50 | 3,000 | 3.03% | 3521.89 | 3554.83 |
| 429 | Harvey Comics Entertai | 06/18/93 | 6.00 | 7.00 | 7.50 | 9.38 | 1,200 | 3.03% | 3494.77 | 3554.83 |
| 430 | Rexall Sundown | 06/18/93 | 11.00 | 13.00 | 14.00 | 16.25 | 2,200 | 3.03% | 3494.77 | 3554.83 |
| 431 | FLIR Sys | 06/22/93 | 10.00 | 12.00 | 12.00 | 11.50 | 2,300 | 3.03% | 3497.53 | 3553.45 |
| 432 | Healthdyne Tech. | 06/22/93 | 9.00 | 11.00 | 9.50 | 10.00 | 1,525 | 3.03% | 3497.53 | 3491.72 |
| 433 | Saratoga Spring Water | 06/23/93 | 5.00 | 6.00 | 5.00 | 7.13 | 1,200 | 3.03% | 3466.81 | 3553.45 |
| 434 | Shiloh Ind Inc. | 06/29/93 | 11.00 | 13.00 | 11.00 | 11.25 | 3,350 | 3.03% | 3518.85 | 3511.93 |
| 435 | Ind. Scientific | 06/30/93 | 14.00 | 16.00 | 16.00 | 18.50 | 750 | 3.03% | 3516.08 | 3491.72 |
| 436 | AER Energy Resources | 07/01/93 | 10.00 | 12.00 | 7.00 | 7.50 | 2,500 | 3.06% | 3510.54 | 3505.01 |
| 437 | BroadBand Tech. | 07/01/93 | 15.00 | 17.00 | 18.00 | 28.50 | 3,500 | 3.06% | 3510.54 | 3505.01 |
| 438 | Pinnacle Micro | 07/01/93 | 10.00 | 12.00 | 10.50 | 11.50 | 1,800 | 3.06% | 3510.54 | 3505.01 |
| 439 | Cyrk Intl | 07/07/93 | 11.00 | 13.00 | 12.00 | 11.38 | 2,000 | 3.06% | 3475.67 | 3521.89 |
| 440 | Genzyme Transgenics | 07/09/93 | 9.00 | 11.00 | 8.00 | 8.13 | 1,500 | 3.06% | 3521.06 | 3494.77 |
| 441 | Cyrix | 07/16/93 | 13.00 | 15.00 | 16.00 | 20.75 | 2,000 | 3.06% | 3528.29 | 3530.20 |
| 442 | Johnstown America Ind. | 07/16/93 | 12.00 | 13.50 | 14.00 | 17.25 | 3,750 | 3.06% | 3528.29 | 3530.20 |
| 443 | Applied Biometrics | 07/20/93 | 3.50 | 3.50 | 3.50 | 4.00 | 1,500 | 3.06% | 3544.78 | 3449.93 |
| 444 | Starcraft Automotive Co | 07/21/93 | 10.00 | 12.00 | 10.00 | 10.00 | 2,150 | 3.06% | 3555.40 | 3510.54 |
| 445 | Hi-Rise Recycling | 07/22/93 | 5.00 | 5.00 | 5.00 | 5.50 | 1,200 | 3.06% | 3525.22 | 3449.93 |

| | Issuer | Offer Date | Low Initial Filing Price | High Initial Filing Price | Final Offer Price | First Trading Day Closing Price | Total Shares Offered Globally (000') | Three Month T Bill Rate | DJIA at Offer Date | DJIA at Red Herring Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 446 | Key Tech. | 07/23/93 | 10.00 | 12.00 | 9.00 | 9.00 | 1,300 | 3.06% | 3546.74 | 3515.44 |
| 447 | Mountain Parks Financi | 07/27/93 | 8.50 | 10.00 | 9.25 | 9.25 | 800 | 3.06% | 3565.46 | 3475.67 |
| 448 | Cygne Designs | 07/30/93 | 9.00 | 11.00 | 10.00 | 10.25 | 2,400 | 3.06% | 3539.47 | 3514.42 |
| 449 | Adv. Surgical | 08/04/93 | 6.00 | 8.00 | 6.50 | 6.00 | 1,500 | 3.00% | 3552.05 | 3542.55 |
| 450 | Best Power Tech. | 08/04/93 | 13.00 | 15.00 | 14.50 | 18.00 | 2,600 | 3.00% | 3552.05 | 3466.81 |
| 451 | Conductus | 08/05/93 | 10.00 | 12.00 | 10.00 | 9.88 | 1,500 | 3.00% | 3548.97 | 3550.93 |
| 452 | EP Tech. | 08/05/93 | 10.00 | 12.00 | 6.50 | 6.75 | 2,000 | 3.00% | 3548.97 | 3550.93 |
| 453 | Motor Coach Ind Intl | 08/05/93 | 14.00 | 16.00 | 13.00 | 12.25 | 20,000 | 3.00% | 3548.97 | 3550.93 |
| 454 | Aetrium | 08/10/93 | 7.50 | 9.00 | 8.75 | 9.25 | 1,500 | 3.00% | 3572.73 | 3544.78 |
| 455 | Wolverine Tube | 08/13/93 | 16.00 | 19.00 | 15.50 | 15.75 | 5,700 | 3.00% | 3569.65 | 3525.22 |
| 456 | Kurzweil Applied Intellig | 08/17/93 | 10.00 | 12.00 | 10.00 | 11.38 | 2,100 | 3.00% | 3586.98 | 3565.46 |
| 457 | Level 1 communications | 08/19/93 | 13.00 | 15.00 | 17.00 | 28.50 | 2,200 | 3.00% | 3612.13 | 3567.42 |
| 458 | Great Wall Electronic Int | 08/25/93 | 10.22 | 10.22 | 9.75 | 9.50 | 2,500 | 3.00% | 3652.09 | 3548.97 |
| 459 | Inbrand | 09/03/93 | 11.50 | 13.50 | 14.00 | 18.00 | 1,800 | 2.96% | 3633.93 | 3569.65 |
| 460 | Cornerstone Imaging | 09/09/93 | 8.50 | 10.00 | 11.00 | 14.50 | 1,800 | 2.96% | 3589.49 | 3612.13 |
| 461 | Adv. Deposition | 09/10/93 | 5.00 | 5.00 | 5.00 | 4.63 | 1,000 | 2.96% | 3621.63 | 3651.25 |
| 462 | PairGain Tech. | 09/15/93 | 10.00 | 12.00 | 14.00 | 19.75 | 4,150 | 2.96% | 3633.65 | 3652.09 |
| 463 | First Midwest Financial | 09/20/93 | 10.00 | 10.00 | 10.00 | 14.75 | 1,918 | 2.96% | 3575.80 | 3449.93 |
| 464 | Cobra Golf | 09/21/93 | 18.00 | 20.00 | 21.00 | 31.75 | 3,250 | 2.96% | 3537.24 | 3569.65 |
| 465 | Asyst Tech. | 09/22/93 | 8.00 | 9.00 | 9.00 | 11.00 | 1,325 | 2.96% | 3547.02 | 3626.10 |
| 466 | Neurex | 09/22/93 | 7.00 | 9.00 | 5.00 | 5.00 | 3,300 | 2.96% | 3547.02 | 3626.10 |
| 467 | OroAmerica | 09/23/93 | 12.00 | 14.00 | 12.00 | 12.25 | 2,250 | 2.96% | 3539.75 | 3633.93 |
| 468 | Royal Grip | 09/23/93 | 9.00 | 11.00 | 12.00 | 20.75 | 1,000 | 2.96% | 3539.75 | 3588.93 |
| 469 | Summa Four Inc | 09/23/93 | 13.00 | 15.00 | 17.00 | 26.25 | 2,200 | 2.96% | 3539.75 | 3607.10 |
| 470 | MicroProbe | 09/29/93 | 6.00 | 8.00 | 6.60 | 5.50 | 2,500 | 2.96% | 3566.30 | 3589.49 |
| 471 | Ultratech Stepper | 09/29/93 | 11.00 | 13.00 | 14.00 | 18.75 | 2,200 | 2.96% | 3566.30 | 3589.49 |
| 472 | Atchison Casting | 10/04/93 | 12.00 | 14.00 | 12.00 | 13.13 | 2,150 | 3.08% | 3577.76 | 3615.76 |
| 473 | National Picture & Fram | 10/05/93 | 11.00 | 13.00 | 10.50 | 9.50 | 2,250 | 3.08% | 3587.26 | 3633.65 |
| 474 | Commerical Bankshare | 10/06/93 | 11.00 | 13.00 | 11.50 | 12.00 | 850 | 3.08% | 3598.99 | 3630.85 |
| 475 | IVI Publishing | 10/06/93 | 12.00 | 15.00 | 14.50 | 18.00 | 1,150 | 3.08% | 3598.99 | 3630.85 |
| 476 | Quad City Holdings | 10/06/93 | 10.00 | 10.00 | 10.00 | 10.00 | 1,200 | 3.08% | 3598.99 | 3630.85 |
| 477 | Micro Component Tech | 10/08/93 | 9.00 | 11.00 | 11.00 | 12.00 | 2,450 | 3.08% | 3584.74 | 3575.80 |
| 478 | Koala | 10/12/93 | 5.00 | 6.00 | 6.00 | 7.63 | 700 | 3.08% | 3593.13 | 3547.02 |
| 479 | Uncle B's Bakery | 10/13/93 | 3.125 | 3.625 | 3.13 | 2.88 | 1,600 | 3.08% | 3603.19 | 3539.75 |
| 480 | Aqua Care Sys | 10/14/93 | 6.00 | 6.00 | 6.00 | 7.50 | 1,050 | 3.08% | 3621.63 | 3537.24 |
| 481 | Wickes Lumber | 10/15/93 | 14.00 | 16.00 | 15.00 | 15.25 | 2,800 | 3.08% | 3629.73 | 3567.70 |
| 482 | EnSys Environmental P | 10/20/93 | 10.00 | 12.00 | 10.00 | 10.00 | 1,800 | 3.08% | 3645.10 | 3555.12 |
| 483 | Harvey Universal | 10/20/93 | 8.00 | 8.00 | 8.00 | 7.75 | 1,250 | 3.08% | 3645.10 | 3555.12 |
| 484 | Tri-Lite Corp | 10/20/93 | 5.00 | 5.00 | 5.00 | 5.00 | 1,000 | 3.08% | 3645.10 | 3555.12 |
| 485 | Duracraft | 10/26/93 | 11.00 | 13.00 | 14.00 | 16.50 | 1,600 | 3.08% | 3672.49 | 3598.99 |
| 486 | Illinois Superconductor | 10/26/93 | 10.00 | 12.00 | 11.25 | 14.75 | 1,350 | 3.08% | 3672.49 | 3555.12 |
| 487 | Acres Gaming | 10/27/93 | 5.00 | 5.00 | 5.00 | 10.00 | 1,450 | 3.08% | 3664.66 | 3537.24 |
| 488 | Cobra Ind. | 10/28/93 | 14.00 | 16.00 | 14.00 | 14.00 | 2,350 | 3.08% | 3687.86 | 3584.74 |
| 489 | Credence Sys | 10/28/93 | 14.00 | 16.00 | 12.00 | 11.75 | 2,500 | 3.08% | 3687.86 | 3584.74 |
| 490 | First State Bancorp. | 11/03/93 | 10.00 | 11.00 | 10.50 | 11.00 | 1,200 | 3.17% | 3661.87 | 3603.19 |
| 491 | Penederm | 11/03/93 | 10.00 | 12.00 | 11.00 | 11.88 | 2,000 | 3.17% | 3661.87 | 3603.19 |
| 492 | Incyte Pharm. | 11/04/93 | 7.00 | 9.00 | 7.50 | 7.50 | 2,000 | 3.17% | 3624.98 | 3621.63 |
| 493 | Greenwich Air Sves. | 11/05/93 | 8.50 | 9.00 | 9.00 | 8.63 | 1,000 | 3.17% | 3643.43 | 3629.73 |
| 494 | Golden Sys | 11/09/93 | 6.00 | 8.00 | 7.00 | 7.63 | 2,500 | 3.17% | 3640.07 | 3543.11 |
| 495 | Purus | 11/09/93 | 12.00 | 14.00 | 14.00 | 14.00 | 1,800 | 3.17% | 3640.07 | 3635.32 |
| 496 | Applied Science & Tech | 11/10/93 | 10.00 | 12.00 | 10.85 | 11.00 | 1,700 | 3.17% | 3663.55 | 3645.10 |
| 497 | Universal Forest Produc | 11/10/93 | 7.00 | 9.00 | 7.00 | 7.63 | 5,000 | 3.17% | 3663.55 | 3673.61 |
| 498 | Big Entertainment | 11/12/93 | 7.00 | 8.00 | 8.00 | 8.50 | 1,500 | 3.17% | 3684.51 | 3649.30 |
| 499 | Quaker Fabric | 11/16/93 | 12.00 | 14.00 | 12.00 | 12.00 | 2,100 | 3.17% | 3710.77 | 3672.49 |

| | Issuer | Offer Date | Low Initial Filing Price | High Initial Filing Price | Final Offer Price | First Trading Day Closing Price | Total Shares Offered Globally (000') | Three Month T Bill Rate | DJIA at Offer Date | DJIA at Red Herring Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 500 | Coflexip | 11/17/93 | 14.00 | 16.00 | 16.00 | 16.75 | 6,740 | 3.17% | 3704.35 | 3664.66 |
| 501 | Uniphase | 11/17/93 | 7.50 | 8.50 | 8.00 | 8.25 | 2,050 | 3.17% | 3704.35 | 3664.66 |
| 502 | Leggoons | 11/18/93 | 3.00 | 4.00 | 3.13 | 2.88 | 900 | 3.17% | 3685.34 | 3687.86 |
| 503 | Arris Pharm. | 11/19/93 | 11.00 | 13.00 | 7.00 | 6.75 | 2,500 | 3.17% | 3694.01 | 3680.59 |
| 504 | Adv. Tech. Materials | 11/23/93 | 7.50 | 9.00 | 7.00 | 6.75 | 1,750 | 3.17% | 3674.17 | 3661.87 |
| 505 | Martek Biosciences | 11/23/93 | 10.00 | 12.00 | 7.00 | 7.00 | 2,000 | 3.17% | 3674.17 | 3661.87 |
| 506 | Photonics Corp | 11/23/93 | 8.00 | 10.00 | 9.00 | 8.75 | 1,875 | 3.17% | 3674.17 | 3697.64 |
| 507 | Vermont Teddy Bear | 11/23/93 | 6.50 | 8.50 | 10.00 | 16.75 | 1,150 | 3.17% | 3674.17 | 3661.87 |
| 508 | Cable Design Tech. | 11/24/93 | 12.00 | 14.00 | 10.00 | 9.88 | 3,500 | 3.17% | 3687.58 | 3624.98 |
| 509 | Airport Sys Intl | 11/30/93 | 10.00 | 12.00 | 10.25 | 10.63 | 1,400 | 3.17% | 3683.95 | 3663.55 |
| 510 | Tower Tech. | 11/30/93 | 6.25 | 6.25 | 6.25 | 6.25 | 680 | 3.17% | 3683.95 | 3663.55 |
| 511 | Grupo Financiero Serfin | 12/01/93 | 22.20 | 22.20 | 24.38 | 25.75 | 15,000 | 3.03% | 3697.08 | 3662.43 |
| 512 | Positron | 12/03/93 | 8.10 | 9.10 | 8.50 | 6.25 | 1,750 | 3.03% | 3704.07 | 3710.77 |
| 513 | Foamex Intl | 12/07/93 | 17.00 | 19.00 | 15.00 | 15.25 | 10,712 | 3.03% | 3718.88 | 3704.35 |
| 514 | Moneterey Pasta | 12/07/93 | 6.00 | 6.00 | 6.00 | 9.50 | 2,050 | 3.03% | 3718.88 | 3583.63 |
| 515 | Symbollon | 12/07/93 | 6.00 | 6.00 | 6.00 | 5.00 | 1,000 | 3.03% | 3718.88 | 3624.98 |
| 516 | CMC Ind. | 12/09/93 | 8.00 | 10.00 | 9.00 | 8.75 | 1,750 | 3.03% | 3729.78 | 3694.01 |
| 517 | Thermo Remediation | 12/09/93 | 11.00 | 13.00 | 12.50 | 12.75 | 1,100 | 3.03% | 3729.78 | 3694.01 |
| 518 | Asante Tech. | 12/10/93 | 13.00 | 15.00 | 12.50 | 11.75 | 2,000 | 3.03% | 3740.67 | 3670.25 |
| 519 | Camco Intl | 12/10/93 | 18.00 | 20.00 | 15.00 | 15.13 | 13,750 | 3.03% | 3740.67 | 3670.25 |
| 520 | Racotek | 12/10/93 | 7.00 | 9.00 | 7.00 | 7.50 | 4,000 | 3.03% | 3740.67 | 3670.25 |
| 521 | Steven Madden | 12/13/93 | 4.00 | 4.00 | 4.00 | 7.63 | 1,500 | 3.03% | 3764.43 | 3603.19 |
| 522 | ABC Rail Products | 12/14/93 | 12.00 | 14.00 | 12.00 | 12.50 | 3,000 | 3.03% | 3742.63 | 3687.58 |
| 523 | Active Voice | 12/14/93 | 14.00 | 16.00 | 15.00 | 18.25 | 1,300 | 3.03% | 3742.63 | 3640.07 |
| 524 | Water Point Sys | 12/14/93 | 5.00 | 5.00 | 5.00 | 5.25 | 2,200 | 3.03% | 3742.63 | 3687.58 |
| 525 | Conso Products | 12/15/93 | 10.50 | 12.50 | 11.25 | 11.25 | 1,350 | 3.03% | 3716.92 | 3683.95 |
| 526 | Stimsonite | 12/15/93 | 10.00 | 12.00 | 9.00 | 10.00 | 2,500 | 3.03% | 3716.92 | 3683.95 |
| 527 | AFC Cable Sys | 12/16/93 | 11.00 | 13.00 | 10.00 | 10.00 | 1,850 | 3.03% | 3726.14 | 3683.95 |
| 528 | Encad | 12/16/93 | 7.00 | 9.00 | 5.00 | 5.38 | 1,500 | 3.03% | 3726.14 | 3683.95 |
| 529 | Planar Sys | 12/16/93 | 9.00 | 11.00 | 7.00 | 7.50 | 3,000 | 3.03% | 3726.14 | 3683.95 |
| 530 | Gunther Intl | 12/21/93 | 5.00 | 5.00 | 5.00 | 4.81 | 1,000 | 3.03% | 3745.15 | 3670.25 |
| 531 | Medis El | 12/21/93 | 6.00 | 8.00 | 8.25 | 9.13 | 1,000 | 3.03% | 3745.15 | 3697.08 |

## References


Allen, F. and Faulhaber, G. (1989). Signaling by underpricing in the IPO market. Journal of Financial Economics, 23, 303-323.

Arthur Anderson. (1995). Securities Offerings in the United States. (Manual for clients).

Association of the Bar of City of New York, 1977. Report by Special Committee on lawyers' role in securities transactions. Business Law, 32, 1879, 1891-98.

Bagwell, L. (1992). Characteristics of shareholder heterogeneity in Dutch auction stock repurchases. Journal of Finance, 47, 71-105.

Bank of England. (1986). New issue costs and methods in the UK equity market. Bank of England Quarterly Bulletin, December, 532-542.

Bank of England. (May, 1990). New equity issues in the UK. Bank of England of Quarterly Bulletin, 243-252.

Baron, D. (1979). The incentive problem and the design of investment banking contracts. Journal of Banking and Finance, 3, 157-75.

Bear, R. and Curley, A. (1975). Unseasoned equity financing. Journal of Financial and Quantitative Analysis, June, 311-25.

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

Benveniste, L. and Spindt, P. (1989). How investment bankers determine the offer price and allocation of new issues. Journal of Financial Economics, 24, 343-361.

Benveniste, L. and Wilhelm, W. (1990). A comparative analysis of IPO proceeds under alternative regulatory environments. Journal of Financial Economics, 28, 173-207.

Bloch, S. and Stanley, M. (1980). The financial characteristics and price movement patterns of companies approaching the unseasoned securities market in the late 1970s. Financial Management, winter, 30-6.

Buckland, R. (1995). Efficient pricing of new equity issues. International Small Business Journal, 14(1), 65-85.

Buckland, R., Herbert, P. and Yeomans, K. (1981). Price discount on new equity issues in the UK and their relationship to investor subscription in the period 1965-75. Journal of Business Finance and Accounting, 8, 79-96.

Buckland, R. and Yeomans, K. (1977). Market efficiency: the role of issuing houses. Journal of Economic Studies, 4, 59-66.

CS First Boston. (1992). Handout re CBA IPO. (Manual for clients).

Carpenter, C. and Strawser, R. (1971). Displacement of auditor when clients go public. Journal of Accountancy, 133, 55-58.

Carter, R. and Manaster, S. (1990). Initial public offering and underwriter reputation. The Journal of Finance, 45 4, 1045-1067.

Chalk, A. and Peavy, J. (1987). Initial public offerings: daily returns, offering types and the price effect. Financial Analysts Journal, 43, 65-69.

Coopers & Lybrand. (1995). Listing and Offering Equity Securities in the United States. (Manual for clients).

Davis, E. and Yeomans, K. (1976). Market discount on new issues of equity: the influence of firm size, method of issue and market volatility. Journal of business Finance and Accounting, 3, 27-42.

Dawson, S. (1987). Secondary stock market performance of initial public offers: Hong Kong, Singapore and Malaysia 1978-1984. Journal of Business Finance and Accounting, 14, 65-76.

Dawson, S. and Hiraki, T. (1985). Selling unseasoned new shares in Hong Kong and Japan: a test of primary market efficiency and underpricing. Hong Kong Journal of Business Management.

Ernst & Young. (1993). Deciding to Go Public. (Manual for clients).

Finn, F. and Higham, R. (1988). The performance of unseasoned new equity issue-cum-stock exchange listings in Australia. Journal of Banking and Finance, 12, 333-335.

Gale, I. and Stiglitz, J. (1989). The information content of initial public offerings. Journal of Finance, 44, 469-477.

Grinblatt, M. and Hwang, C. (1989). Signaling and the pricing of unseasoned new issues. Journal of Finance, 44, 393-420.

Grossman, S. (1976). On the efficiency of competitive stock markets where traders have diverse information. Journal of Finance, 31, 573-585.

Hanley, K., Kumar, A. and Seguin, P. (1993). Price stabilization in the market for new issues. Journal of Financial Economics, 34, 177-197.

Hegde, S. and Miller, R. (1989). Market-making in initial public offerings: an empirical analysis. Journal of Financial and Quantitative Analysis, 24, 75-90.

Hess, A. and Frost, P. (1982). Tests for price effects of new issues of seasoned securities. Journal of Finance, 37, 11-26.

Hongkong Shanghai Banking Corporation. (1994). (Manual for Clients).

Hughes, P. (1986). Signaling by direct disclosure under asymmetric information. Journal of Accounting and Economics, 8, 120-142.

Ibbotson, R. (1975). Price performance of common stock new issues. Journal of Financial Economics, 2, 235-272.

Ibbotson, R. (1982). Common stock new issues revisited (Working paper 84). University of Chicago Center for Research in Security Prices, Chicago, IL.

Ibbotson, R. and Jaffe, J. (1975). "Hot issue" markets. Journal of Finance, 30, 1027-1042.

Ibbotson, R., Sindelar, J. and Ritter, J. (1988). Initial public offerings. Journal of Applied Corporate Finance, 1, 37-45.

Ibbotson, R. and Ritter, J. (1993). Initial public offerings. In R. Jarrow, V. Maksimovic and W. Ziemba (Eds.). Handbooks of Operations Research and Management Science: Finance. Amsterdam: North-Holland.

Johnson, C. (1991). Corporate Finance and Securities Laws. New Jersey: Prentice Hall Law & Business.

Johnson, J. and Miller, R. (1988). Investment banker prestige and the underpricing of initial public offerings. Financial Management, 17, 19-29.

Keloharju, M. (1993). The winners' curve, legal liability, and the long-run price performance of initial public offerings in Finland. Journal of Financial Economics, 34, 251-277.

Koh, F. and Walter, T. (1989). A direct test of Rock's model of the pricing of unseasoned issues. Journal of Financial Economics, 23, 251-272.

Lehman Brothers. (1996). Letter to Client.

Lehman Brothers. (1996). Marketing, Bookbuilding, Pricing, Allocation and Valuation. (Manual for clients).

Leland, H. and Pyle, D. (1977). Informational asymmetries, financial structure and financial intermediation. Journal of Finance, 32, 371-387.

Levis, M. (1990). The winner's curse problem, interest costs and the underpricing of initial public offerings. Economic Journal, 100, 76-89.

Levis, M. (1993). The long-run performance of initial public offerings: the UK experience 1980-1988. Financial Management, 22, 28-41.

Linklaters & Paines. (1996). US Registered Offering. (Letter to Client).

Loderer, C., Cooney, J. and Van Drunen, L. (1991). The price elasticity of demand for common stock. Journal of Finance, 46, 621-651.

London Stock Exchange. (1995). Listing Rules.

Logue, D. (1973). On the pricing of unseasoned equity issues, 1965-69. Journal of Financial and Quantitative Analysis, 8, 91-104.

Mandeller, G. and Raviv, A. (1977). Investment baking: an economic analysis of optimal underwriting contracts. Journal of Finance, 32, 683-694.

Masulis, R. (1980). The effect of capital structure change on securities prices: a study of exchange offers. Journal of Financial Economics, 8, 139-178.

Masulis, R. and Korwar, A. (1986). Seasoned equity offerings: an empirical investigation. Journal of Financial Economics, 15, 91-118.

McDonnal, J. and Fisher, A. (1972). New issue stock price behavior. The Journal of Finance, 27, 97-102.

McStay, K.P. (1987). The efficiency of new issue markets. Unpublished doctoral dissertation, University of California Los Angles, CA.

Merritt, A., Howe, M. and Newbould. G. (1967). Equity issues and the London capital market. New York: Longmans.

Michaely, R. and Shaw, W. (1992). The pricing of initial public offerings: tests of the adverse selection and signaling theories. Working paper, Cornell University, Ithaca, NY.

Miller, R. and Reilly, F. (1987). An examination of mispricing, returns, and uncertainty for initial public offerings. Financial Management, 16, 33-38.

Muscarella, C., Peavy, J. and Vetsuypens, M. (1992). Optimal exercise of the over-allotment option in IPOs. Financial Analysts Journal, May/June, 76-80.

Muscarella, C. and Vetsuypens, M. (1989). A simple test of Baron's model of IPO underpricing. Journal of Financial Economics, 24, 125-135.

Muscarella, C. and Vetsuypens, M. (1989). The underpricing of 'second' initial public offerings. Journal of financial Research, 12, 183-192.

Neuburger, B. and Hammond, C. (1974). A study of underwriters experience with unseasoned new issues. Journal of Financial and Quantitative Analysis, March, 165-77.

Neuburger, B. and LaChapelle. C. (1983). Unseasoned new issue price performance on three tiers: 1975-1980. Financial Management, Autumn, 23-28.

New York Stock Exchange Guide. ¶24954A-2495E.

Price Waterhouse. (1993). The Going Public Handbook. (Manual for clients).

Regulation S-X under Securities Act.

Regulation S-K under Securities Act.

Regulation F-1 under Securities Act.

Reilly, F. (1973). Further evidence on short-run results of new issue investors. Journal of Financial and Quantitative Analysis, January, 73-80.

Reilly, F. (1977). New issues revisited. Financial Management, winter, 28-42.

Reilly, F. and Hatfield, K. (1969). Investor experience with new stock issues. Financial Analysts Journal, 25, 73-80.

Ritter, J. (1984a). The 'hot issue' market of 1980. Journal of Business, 57, 215-240.

Ritter, J. (1984b). Signaling and the valuation of unseasoned new issues: a comment. Journal of Finance, 39, 1231-1237.

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

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

Rogers, E. (1963). The Diffusion of Innovation. Glencoe, IL: Free Press.

Ruud, J. (1990). Underpricing of initial offerings: goodwill, price shaving, or price support. Unpublished doctoral dissertation, Harvard University, Cambridge, MA.

Ruud, J. (1993). Underwriter price support and the IPO underpricing puzzle. Journal of Financial Economics, 34, 135-151.

Samuel Montagu. (1995). Going Public. (Manual for clients).

Salomon Brothers. (1996). Handout for PRC Clients.

Salomon Brothers. (1994). Accessing the US equity capital markets. (Manual for clients).

Securities Act of 1933.

Securities Exchange Act of 1934.

Securities Enforcement Remedies and Penny Stock Reform Act of 1990.

Securities Exchange Act Release No.2446, March 18, 1940.

SEC Securities Act Release No. 4697, May 28, 1964.

SEC Securities Act Release No. 3844, October 8, 1967.

SEC Securities Act Release No. 5009, October 7, 1969.

SEC Securities Act Release Nos. 6331-38, August 6, 1981.

SEC Securities Act Release No. 6383, March 16, 1982.

SEC Securities Act Release No. 30608, April 20, 1992.

SEC Securities Act Release No. 6949, July 30, 1992.

SEC Securities Act Release No. 6950, July 30, 1992.

SEC New Digest, November 17, 1980.

Schneider, C., 1972. Nits, grits and soft information in SEC filings. University of Pennsylvania University Law Review, 12, 254.

15 US Codes, 1988.

17 Codes of Federal Regulation, 1991.

Schultz, P. and Zaman, M. (1994). Aftermarket support and under- pricing of initial public offerings. Journal of Financial Economics, 35, 199-219.

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

Stoll, H. (1976). The pricing of underwritten offerings of listed common stocks and the compensation of underwriters. Journal of Economics and Business, 28, 96-103.

Stoll, H. and Curley, A. (1970). Small business and new issues market for equities. Journal of Financial and Quantitative Analysis, September, 309-22.

Tinic, S. (1988). Anatomy of initial public offerings of common stock. Journal of Finance, 43, 789-822.

Titman, S. and Truman, B. (1986). Information quality and the valuation of new issues. Journal of Accounting and Economics, 8, 159-172.

Welch, I. (1989). Seasoned offerings, imitation costs, and the underpricing of initial public offerings. Journal of Finance, 44, 421-449.

Wong, K. and Chiang, H. (1986). Pricing of new equity issues in Singapore. Asia Pacific Journal of Management, 4 1, 1-10.

## Bibliography


Acharya, S. (1988). Am empirical test of managerial self-interest on corporate capital structure. Journal of Finance, 43, 413-429.

Affleck-Graves, J., Hegde, S. and Miller, R. (1991). Therelationship between the first day return and the aftermarket performance of initial public offerings. Unpublishedmanuscript, Northern Illinois University.

Aggarwal, R. and Rivoli, P. (1990). Fads in the initial public offering market? Financial Management, 19, 45-57.

Aggarwal, R., leal, R. and Hernandez, F. (1993). The aftermarket performance of initial public offerings in Latin America. Journal of Management, Spring, 42-53.

Akerlof. G. (1970). The market for lemons: quality uncertainty and the market mechanism. Quarterly Journal of Economics, 84, 488-500.

Alchian, A. and Demsetz, H. (1972). Production, information costs and economic organization. American Economic Review, 52, 777-95.

Alchian, A. and Allen, W. (1977). Exchange and Production: Competition. Coordination, and Control (2nd ed.). CA: Wadsworth.

Allen, F. and Faulhaber, G. (1988). Optimism invites deception. Quarterly Journal of Economics, 103, 397-407.

Allen, F. and Faulhaber, G. (1989). Signalling by underpricing in the IPO market. Journal of Financial Economics, 23, 303-323.

Allen, F. and Postlewaite, A. (1984). Rational expectations and the measurement of a stock's elasticity of demand. Journal of Finance. 39. 119-1125.

Amemiya, T. (1979). The estimation of a simultaneous equation to bit model. International Economic Review, 20, 169-181.

Amiud, Y. and Mendelson, H. (1986). Asset pricing and the bid-ask spread. Journal of Financial Economics, 17, 223-249.

Amiud, Y. and Mendelson, H. (1989). The effects of beta, bid-ask spread. residual risk, and size on stock returns. Journal of Finance. 44. 479-486.

Asquith, P. and Mulins, D. (1986). Equity issues and offering dilution. Journal of Financial Economics, 15, 61-89.

Australian Government. (1981). Australian Financial system: Final Report of the Committee of Inquiry. Canberra: Australian Government Publishing Service.

Bacon, J. and Brown, J. (1975). Corporate Directorship Practices: Role Selection and Legal Status of the Board. New York: Conference Board.

Bagwell, L. (1992). Characteristics of shareholder heterogeneity in Dutch auction stock repurchases. Journal of Finance, 47, 71-105.

Ball, R. and Brown, P. (1968). An empirical evaluation of accounting income numbers. Journal of Accounting Research, 6 2, 159-178.

Ball, R. and Finn, F. (1985). The effect of large transactions on share prices experimental issues and Australian evidence. Unpublished manuscript University of New South Wales, Australian Graduate School of Management Kensington.

Bank of England. (1986). New issue costs and methods in the UK equity market. Bank of England Quarterly Bulletin. December, 532-542.

Banz, R. (1981). The relationship between return and market value of common stocks. Journal of Financial Economics, March, 3-18.

Barclay, M. and Litzenberger, R. (1988). Announcement effects of new equity issues and the use of intraday price data. Journal of Financial Economics. 21. 71-99.

Baron, D. (1979). The incentive problem and the design of investment banking contracts. Journal of Banking and Finance, 3, 157-75.

Baron, D. (1982). A model of the demand for investment banking, advising and distribution services for new issues. Journal of Finance, 37, 955-976

Baron, D. and Holmstrom, B. (1980). The investment banking contract for new issues under asymmetric information: delegation and the incentive problem. Journal of Finance, 35, 1115-38.

Barry, C. and Brown, S. (1984). Differential information and the small firm effect. Journal of Financial Economics, 13, 283-294.

Barry, C. and Brown, S. (1985). Differential information and security market equilibrium. Journal of Financial and Quantitative Analysis, 20, 407-22.

Barry, C. and Jennings, R. (1992). The opening price performance of initial public offerings of common stock. Financial Management, 22, 54-63.

Barry, C., Muscarella, C., Peavy, J. and Vetsuypens, M. (1990). The role of venture capital in the creation of public companies: Evidence from the going-public process. Journal of Financial Economics, 27, 447-472.

Barry, C., Muscarella, C. and Vetsuypens, M. (1991). Underwriter warrants, underwriter compensation, and the costs of going public. Journal of Financial Economics, 29, 113-136.

Basu, S. (1977). Investment performance of common stocks in relation to their price-earnings ratios: a test of the efficient market hypothesis. Journal of Finance, 32, 663-681.

Bear, R. and Curley, A. (1975). Unseasoned equity financing. Journal of Financial and Quantitative Analysis, June, 311-25.

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

Benston, G. and Hagrman, R. (1974). Determinatns of bid-ask spreads in the over-the-counter market. Journal of Financial Economics, 1, 353-364.

Benveniste, L. and Spindt, P. (1989). How investment bankers determine the offer price and allocation of new issues. Journal of Financial Economics, 24, 343-361.

Benveniste, L. and Wilhelm, W. (1990). A comparative analysis of IPO proceeds under alternative regulatory environments. Journal of Financial Economics, 28, 173-207.

Besanko, D. and Kanatas, G. (1991). The regulation of bank capital: time-consistency, hedging, and incentive-compatibility. Working paper, University of South Florida, Tampa, Fl.

Bevan, J. (1978, July 28). Are the issuing houses getting it wrong? Investors' Chronicle, 293.

Bhagat, S. (1983). The effect of pre-emptive right amendments on shareholder wealth. Journal of Financial Economics, 12, 289-310.

Bhagat, S., Marr, M. and Thompson, G. (1985). The rule 415 experiment: equity markets. Journal of Finance, 40, 1385-1410.

Bhagat, S. and Frost, P. (1986). Issuing costs to existing shareholders in competitive and negotiated underwritten public utility equity offerings. Journal of Financial Economics, March, 233-259.

Bhattacharya, S. (1977). An exploration of nondissipative dividend-signaling structures. Working paper, University of Chicago, Graduate School of Business, Chicago, IL.

Bhattacharya, S. (1979). Imperfect information, dividend policy, and 'the bird in the hand' fallacy. Bell Journal of Economics, 10, 259-270.

Bhattacharya, S. (1980). Nondissiputive signalling structures and dividend policy. Quarterly Journal of Economics, 95, 1-24.

Bhattacharya, S. and Ritter, J. (1983). Innovation and communication: signalling with partial disclosure. Review of Economic Studies, 50, 331-346.

Bialkin, K. and Grant, W. (1985). Securities Underwriting: A Practitioner's Guide. New York: Practising Law Institute.

Bikhchandani, S. and Huang, C.. (1989). Auctions with resale markets: an exploratory model of Treasury bill markets. Review of Financial Studies 2, 311-340.

Black, F. (1972). Capital market equilibrium with restricted borrowing. Journal of Business, 45, 444-455.

Black, F., Jensen, M. and Scholes, M. (1972). The capital asset pricing model: some empirical results. In M. Jensen (Ed.), Studies in the Theory of Capital Markets, New York: Praeger.

Black, F. and Scholes, M. (1973). The pricing of options and corporate liabilities. Journal of Political Economy, 81, 637-654.

Blattberg, R. and Gonedes, N. (1974). A comparison of the stable-paretion and student distribution as statistical models for prices. Journal of Business, 47, 244-80.

Blazenko, G. (1989). Underpricing of unseasoned equity issues,after-market performance, and the winner's cures. Unpublished working paper. Simon Fraser University, Burnaby.

Bloch, E. (1989). Inside Investment Banking. Homewood, IL: Dow Jones-Irwin.

Bloch, S. and Stanley, M. (1980). The financial characteristics and price movement patterns of companies approaching the unseasoned securities market in the late 1970s. Financial Management, winter, 30-6.

Blume, M. and Husic, F. (1973). Price, beta, and exchange listing. Journal of Finance, 28, 283-99.

Bloomenthal, H. (1992). Going Public and the Public Corporation. Deerfield, IL: Clark, Boardman and Callaghan.

Booth, J. and Smith, R. (1986). Capital raising, underwriting and the certification hypothesis. Journal of Financial Economics, 15, 261-281.

Box, G. and Cox, D. (1964). An analysis of transformation. Journal of the Royal Statistical Society, 26B, 211-243.

Box, G. and Jenkins, G. (1970). Time Series Analysis. San Francisco Holden-Day.

Boyvr, E. and Fizptims, T. (1969). Elementary Differential Equations and boundary Value Problems. New York: Wiley.

Bradley, M., Desai, A. and Kim, E. (1983). The rationale behind interfirm tender offers: information or synergy? Journal of Financial Economics, 11, 183-206.

Bradley, M. and Wakeman, L. (1983). The wealth effects of targeted share repurchases. Journal of Financial Economies, 11, 301-328.

Brealey, R. and Myers, S. (1988). Principles of Corporate Finance. New York: McGraw-Hill.

Brennan, M. and Schwartz, E. (1978). Corporate income taxes, valuation, and the problem of optional capital structure. Journal of Business, 51, 103-114

Brennan, M. and Copeland, T. (1988). Stock splits, stock prices, and transactions costs. Journal of Financial Economics, 22, 83-101.

Brickley, J. (1983). Shareholder wealth, information signaling and the specially designated dividend: an empirical study. Journal of Financial Economics, 12, 187-209

Brigham, E. and Gapenski, L. (1987). Intermediate Financial Management. Chicago: Dryden Press.

Briston, R., Tomkins, C. and King, D. (1971). Shareholder behavior in the new issues market - a preliminary report. Accounting and Business Research. Summer, 233-241.

Briston, R. (1972). The organization of research into shareholder behavior. Journal of Business Finance, 4, 24-30.

Brittain, J. (1966). Corporate Dividend Policy. Washington, D.C.: The Brookings Institution.

Brown, J. (1970). Post offering experience of companies going Public. Journal of Business, 43, 10-18.

Brown, S. and Warner, J. (1980). Measuring security price performance. Journal of Financial Economics, 8, 205-257.

Brownlee, K. (1967). Statistical Theory in Science and Engineering. New York: Wiley & Sons, Inc.

Buckland, R. (1995). Efficient pricing of new equity issues. International Small Business Journal, 14(1), 65-85.

Buckland, R. and Davis, E. (1987). Barriers to entry in the unlisted securities market: the significance of administrative expense. Accounting and Business Research, 68, 301-310.

Buckland, R., Herbert, P. and Yeomans, K. (1981). Price discount on new equity issues in the UK and their relationship to investor subscription in the period 1965-75. Journal of Business Finance and Accounting, 8, 79-96.

Buckland, R. and Yeomans, K. (1977). Market efficiency: the role of issuing houses. Journal of Economic Studies, 4, 59-66.

Burton, J. and Roberts, W. (1976). A study of auditor changes. Journal of Accountancy, 31-36

Buser, S., Chen, A., and Kane, E. (1981). Federal deposit insurance, regulatory policy and optimal bank deposit. Journal of Finance, 35, 51-60.

Buser, S. and Chan, K. (1987). NASDAQ/NMS qualification standards, Ohio registration experience and the price performance of initial public offerings. Columbus, OH: Department of Commerce and National Association of Securities Dealers, Inc.

Carpenter, C. and Strawser, R. (1971). Displacement of auditor when clients go public. Journal of Accountancy, 133, 55-58.

Carron, A. (1982). The Plight of the S&L Institutions. Washington, D.C.: Brookings Institute.

Carter, R. and Dark, F. (1989). Alternative measures of underwriter reputation: an empirical analysis. Unpublished manuscript, Iowa State University, IA.

Carter, R. and Manaster, S. (1990). Initial public offering and underwriter reputation. The Journal of Fiance, 45 4, 1045-1067.

Chalk, A. and Peavy, J. (1987a). Initial public offerings: daily returns, offering types and the price effect. Financial Analysts Journal, 43, 65-69.

Chalk, A. and Peavy, J. (1987b). Why you'll never get a 'hot' new issue. AAII Journal, 9, 16-20.

Chalk, A. and Peavy J. (1989). Understanding the pricing of initial public offerings. In A. Chen (Ed.). Research in Finance. Greenwich, CT: JAI Press.

Chan, L. and Lakonishok, J. (1990). Robust measurement of beta risk. Unpublished working paper, University of Illinois.

Chapman, D., Tyrell, T. and Mount, T. (1972). Electricity demand growth and the energy crisis. Science, 178, 705.

Charest, G. (1978). Dividend information, stock returns, and market efficiency-II. Journal of Financial Economics, 6, 297-330.

Chemmanur, T. (1993). The pricing of initial public offerings: a dynamic model with information production. Journal of Finance, 48, 285-304.

Cho, I. and Kreps, D. (1987) Signalling games and stable equilibria. Quarterly Journal of Economics, 102, 179-221.

Cho, I. (1987). A refinement of sequential equilibrium. Econometrica, 55, 1367-1389.

Christie, A. (1981). The stochastic behavior of common stock variances: value, leverage and interest rate effects. Journal of Financial Economics, December, 407-432.

Clarkson, P. and Thompson, R. (1987). Stock prices and market risk: implications and tests of the differential information model. Unpublished manuscript, Simmon Fraser University, Burnaby.

Clarkson, P. and Thompson, R. (1990). Empirical estimates of beta when investors face estimation risk. Journal of Finance, 45, 431-453.

Cohen, K., Maier, S. Schwartz, R., and Whitcomb, D. (1978). The returns generation process, returns variance and the effect of thinness in securities markets. Journal of Finance, March, 149-167.

Conrad, J. and Niden, C. (1991). Order flow, trading costs and corporate acquisition announcements. Working paper, University of North Carolina, Chapel Hill, NC and University of Notre Dame, Southbend, IN..

Cooper, R. (1984). On allocative distortions in problems of self-selection. Rand Journal of Economics, 15, 568-578.

Cootner, P. (ed.) (1964). The Random Character of Stock Market Prices. Cambridge, Mass: MIT Press.

Copeland, T. (1979). Liquidity changes following stock splits. Journal of Finance, 34, 115-141.

Copeland, T. and Galai, D. (1983). Information effects on the bid-ask spread. Journal of Finance, 38, 1457-1469.

Cornett, M. and Tehranian, H. (1989). Stock market reactions to the depository institutions deregulation and monetary control act of 1980. Journal of Banking and Financing, 15, 81-100.

Corneet, M. and Tehranian, H. (1990). An examination of the Garn-St. Germain depository institutions act of 1982 on commercial banks and savings and loans. Journal of Finance, 45, 95-111.

Cornett, M. and Tehranian, H. (1994). An examination of voluntaryversus involuntary security issuances by commercial banks. Journal of Financial Economics, 35, 99-122.

Crouchy, M. and Galai, D. (1986). An economic assessment of capital requirements in the banking industry. Journal of Banking and Finance, 10, 231-241.

Dann, L. (1981). Common stock repurchases: an analysis of returns to bondholders and stockholders. Journal of Financial Economics, 9, 113-138.

Dann, L., and DeAngelo, H. (1983). Standstill agreements, privately negotiated stock repurchases and the market for corporate control. Journal of Financial Economics, 11, 275-300.

Dann, L., Masulis, R., and Mayers, D. (1991). Repurchase tender offers and earnings information. Journal of Accounting and Economics, 14, 217-251.

Dann, L. Mayers, D. and Raab, R. (1977). Trading rules, large blocks and the speed of price adjustment. Journal of Financial Economics, 4, 3-22.

Dann, L., and Mikkelson, W. (1984). Convertible debt issuance, capital structure change and financing-related information: some new evidence. Journal of Financial Economics, 13, 157-186.

Dasgupta., P., Hommond, P. and Maskin, E. (1979). Implementation of social choice rules: some results on incentive compatibility. Review of Economic Studies, 46, 185-216.

Davey, P. (1976). Investment Banking Arrangements. New York: Conference Board.

Davis, E. and Yeomans, K. (1975). Company Finance and the Capital Market: A Study of the Effects of Firm Size DAE Occasional paper (39). New York: Cambridge University Press.

Davis, E. and Yeomans, K. (1976). Market discount on new issues of equity: the influence of firm size, method of issue and market volatility. Journal of business Finance and Accounting, 3, 27-42.

Dawson, S. (1984a). Overbidding for new share issues. SingaporeStock Exchange Journal, June, 1-10.

Dawson, S. (1984b) Underpricing new share issues: is Singapore an immature market? Singapore Management Review, 1-10.

Dawson, S. (1985). Raising capital with new share issues: the issuer's view. Malaysian Management Review, August, 49-55.

Dawson, S. (1987). Secondary stock market performance of initial public offers: Hong Kong, Singapore and Malaysia 1978-1984. Journal of Business Finance and Accounting, 14, 65-76.

Dawson, S. and Hiraki, T. (1985). Selling unseasoned new shares in Hong Kong and Japan: a test of primary market efficiency and underpricing. Hong Kong Journal of Business Management.

DeAngelo, H., DeAngelo, L., and Rice, E. (1984). Going private minority freezeouts and shareholder wealth. Journal of Law and Economics, 27, 367-401.

DeAngelo, H. and Masulis, R. (1980). Optimal capital structure under corporate and personal taxation. Journal of Financial Economics, 8, 3-29.

DeAngelo, L. (1981). Auditor independence, 'low balling' and disclosure regulation. Journal of Accounting and Economics, 3, 113-127.

DeBondt, W. and Thaler, R. (1985). Does the stock market overreact? Journal of Finance, 40, 793-805.

Ricotta, A. (Ed.) (1985). Five Year Directory of Corporate Financing 1980-1984. New York: Mason Slaine.

DeGroot, M. (1970). Optimal Statistical Decisions. New York: McGraw-Hill.

Demsetz, H. (1968). The cost of transaction. Quarterly Journal of Economics, 82, 33-53.

Demsetz, H. (1983). The structure of ownership and the theory of the firm. Journal of Law and Economics, 26, 375-390.

Demsetz, H. and Lehn, K. (1984). The structure of corporate ownership: causes and consequences. Working paper, University of California Los Angles, CA. Diedonne, J. (1969). Foundations of Modern Analysis. New York: Academic Press.

Dietrich, K. and James, C. (1983). Regulation and the determination of bank capital changes: a note. Journal of Finance, 38, 1651-1658.

Dietrich, R. (1984). Effects of early bond refundings: an empirical investigation of security returns. Journal of Accounting and Economics, 6, 67-96.

Dimond, D. (1984). Financial intermediation and delegated monitoring. Review of Economic Studies, 51, 393-414.

Dimson, E. (1979a). Risk measurement when shares are subject to infrequent trading. Journal of Financial Economics, 7, 197-226.

Dimson, E. (1979b). The Efficiency of the British New Issue Market for Ordinary Shares. Unpublished doctoral thesis, London Business School, London.

Dimson, E. (1980). Risk measurement when shares are subject to infrequent trading. Journal of Financial Economics, June, 197-226.

Dimson, E., and March, P. (1986). Event study methodologies and the size effect: the case of UK press recommendations. Journal of Financial Economics, 17, 113-142.

Dimson, E., and March, P. (1991). The Hoare Govett Smaller Companies Index 1991. London: Hoare Govett Investment Research Limited.

Dodd, P. (1980). Merger proposals, management discretion and tockholder wealth. Journal of Financial Economics, 8, 105-138.

Dodd, P., and Warner, J. (1983). On corporate governance: a study of proxy contests. Journal of Financial Economics, 11, 401-438.

Downes, D. and Heinkel, R. (1982). Signalling and the valuation of unseasoned new issues. Journal of Finance, 37, 4-7.

Drake, P, and Vetsuypens, M. (1992). IPO underpricing and insurance against legal liability. Financial Management, 22, 64-73.

Dunham, C. (1985). Mutual-to-stock conversion by thrifts: implications for soundness. New England Economic Review, January/Febrebary, 31-45.

Dyl, E. and Joehnk, M. (1976). Competitive versus negotiated underwriting of public utility debt. Bell Journal of Economics, 7, 680-689.

Easterbrook, F. (1983). Two agency-cost explanations of dividends. American Economic Review, 74, 650-659.

Eckbo, E. (1983). Horizontal mergers, collusion, and stockholder wealth. Journal of Financial Economics, 11, 241-273.

Eckbo. E. (1986). Valuation effects of corporate debt offerings. Journal of Financial Economics, 15, 119-151.

Eckbo, E., Maksimovic, V., and Williams, J. (1990). Cross-sectional models in event studies: consistent estimators with an application to horizontal mergers. Review of Financial Studies, 3, 343-367.

Ederington, L. (1975). Uncertainty competition, and costs in corporation bond underwriting. Journal of Financial Economics, 2, 71-94.

Ederington, L. (1976). Negotiated versus competitive underwritings of corporate bonds. Journal of Finance, 31, 17-28.

Edmister, R. (1980). Financial Institutions: Markets and Management New York: McGraw-Hill.,

Elton, E. (1970). Capital rationing and external discount rates. Journal of Finance, 25 3, 573-584.

Engers, M. (1984). The existence and uniqueness of signalling equilibria Unpublished doctoral dissertation, University of California Los Angles. CA.

Engers, M. (1987). Signalling with many signals. Econometrica. 55. 663-674.

Evans, R. (1980). On the existence, measurement, and economic significance of market pressure in the pricing of new equity issues. Unpublished doctoral dissertation, University of Wisconsin, Madison, WI.

Famma, E. (1965). The behavior of stock market prices. Journal of Business. 38, 34-105.

Famma, E. (1970). Efficient capital markets: a review of theory and empirical work. Journal of Finance, 25 2, 383-417.

Famma, E. (1975). Short-term interest rates as predictors of inflation. American Economic Review, June, 269-282.

Famma, E. (1976). Inflation uncertainty and the expected return on treasury bills. Journal of Political Economy, June, 427-448.

Famma, E. (1978). The effect of a firm's investment and financing decisions. American Economic Review, 68, 272-284.

Famma, E. (1980). Agency problems and the theory of the firm. Journal of Political Economy, 88, 288-307.

Famma, E., Fisher, L., Jensen, M. and Roll, R. (1969). The adjustment of stock prices to new information. International Economic Review, 10 1, 1-21.

Famma, E. and Gibbons, M. (1982). Inflation, real returns and capital investment. Journal of Monetary Economics, May, 397-424.

Famma, E. and Jensen, M. (1985). Residual claims and investment decisions. Journal of Financial Economics, 14, 101-119.

Famma, E. and MacBeth, J. (1973). Risk, return and equilibrium: empirical tests. Journal of Political Economy, 81, 607-636.

Famma, E. and Schwert, W. (1977). Asset returns and inflation. Journal of Financial Economics, November, 115-146.

Farrell, M. (1962). On the structure of the capital market. Economic Journal. 72.

Federal Home Loan Bank Board. (1983). Guidelines for Appraisal Reports for Valuation of Savings and Loan Associations and Savings Banks Converting from Mutual to Stock Form of Organization. Mimco: Federal Home Loan Bank Board.

Finn, F. and Higham, R. (1988). The performance of unseasoned new equity issue-cum-stock exchange listings in Australia. Journal of Banking and Finance. 12, 333-335.

Fisher, L. (1959). Determinants of risk premiums on corporate bonds. Journal of Political Economy, 67, 217-237.

Fisher, L. (1961). The Theory of Interest. New York: Kelley.

Flannery, M. (1982). Retail bank deposits as quasi-fixed factors of production. American Economic Review, June, 527-536.

Flannery, M. and James, C. (1984). The effect of interest rate change on the common stock returns of financial institutions. Journal of Finance, 39, 1141-1153.

Folger, R., John, K. and Tipton, J. (1981). Three factors, interest rate differentials and stock groups. Journal of Finance, 36, 323-335.

French, K., Ruback, R. and Schwert, W. (1983). Effects of nominal contracting on stock returns. Journal of Political Economy, January, 70-96.

French, K. and Roll, R. (1986). Stock return variances: the arrival of information and the reaction of traders. Journal of Financial Economics, 17, 5-26.

Friend, I., Longstreet, J., Mendelson, M., Miller, E. and Hess, A.(1967). Investment Banking and the New Issues Market. Cleveland: The World Publishing Company.

Furst, R. (1970). Does listing increase the market price of common stocks? Journal of Business, 43, 174-180.

Galai, D. and Masulis, R. (1976). The option pricing model and the risk factor of stock. Journal of Financial Economics, 3, 53-82.

Gale, I. (1987). Sequential trading in a competitive asset market with informed traders. Unpublished paper, University of Wisconsin, WI.

Gale, I. and Stiglitz, J. (1989). The information content of initial public offerings. Journal of Finance, 44, 469-477.

Garfinkel, J. (1993). IPO Underpricing, insider selling, and subsequent equity offering: is underpricing a signal of quality? Financial Management, 22, 74-83.

Giammarino, R., and Lewis, T. (1988). A theory of negotiated equity financing. Review of Financial Studies, 1, 265-288.

Gilson, R. and Kraakman, R. (1984). The machanisms of market efficiency. Virginia Law Review, 70, 549-644.

Glosten, L. and Milgrom, P. (1985). Bid, ask, and transaction prices in a specialist market with heterogeneously informed traders. Journal of Financial Economics, March, 71-100.

Going Public: the IPO Reporter, 1975-1980. Philadelphia, PA: Howard & Co.

Goldberger, A. (1964). Econometric Theory. New York: John Wiley & Sons.

Gottlieb, G. and Kalay, A. (1983). Implications of the discreteness of observed stock prices. Working paper, New York University, Department of Finance, NY.

Goulet, W. (1974). Price changes managerial actions and insider trading at the time of listing. Financial Management, 3, 30-36.

Graham, B., Dodd, D. and Cottle, S. (1962). Security Analysis (4th ed.). New York: McGraw-Hill.

Green, J. and Laffont, J.. (1977). Characterization of satisfactory mechanisms for the revelation of preferences for public goods. Econometrica, 45, 427-38.

Grinblatt, M. and Hwang, C. (1989). Signalling and the pricing of unseasoned new issues. Journal of Finance, 44, 393-420.

Grossman, S. (1976). On the efficiency of competitive stock markets where traders have diverse information. Journal of Finance, 31, 573-585.

Grossman, S. (1981). The information role of warranties and private disclosure about product quality. Journal of Law and Economics, 24, 461-483.

Grossman, S. and Hart. O. (1980). Takeover bids, the free rider problem and the theory of the corporation. Bell Journal of Economics, Spring, 42-64.

Grossman, S. and Perry, M. (1986a). Sequential bargaining under asymmetric information. Journal of Economic Theory, 39, 120-154.

Grossman, S. and Perry, M. (1986b). Perfect sequential equilibrium. Journal of Economic Theory, 39, 97-119.

Grove, M. (1974). On duration and the optimal maturity structure of the balance sheet. Bell Journal of Economics, Autumn, 696-707.

Guasch, J. and Weiss, A. (1980). Wages as sorting mechanisms in competitive markets with asymmetric information: a theory of testing. Review of Economic Studies, 47, 653-64.

Guasch, J. and Weiss, A. (1981). Self-selection in the labor market American Economic Review, 71, 275-284.

Halloran, M. (1979). Going Public (3rd ed.). New York: Sorg Printing Co.

Hanley, K. (1993). The underpricing of initial public offerings and the partial adjustment phenomenon. Journal of Financial Economics, 34, 231-250.

Hanley, K., Kimar, A. and Seguin, P. (1993). Price stabilization in the market for new issues. Journal of Financial Economics, 34, 177-197.

Hanley, K. and Ritter, J. (1992). Going public. In P. Newman, M. Milgate and J. Eatwell (Eds.). The New Palgrave Dictionary of Money and Finance. London: Stockton Press.

Hanley, K. and Wilhelm, W. (1993). Evidence on the strategic allocation of initial public offerings. Working paper, University of Michigan, Ann Arbor, MI and Boston College, Chestnut Hill, MA.

Hansen, R. and Pinkerton, J. (1982). Direct equity financing: a resolution of a paradox. Journal of Finance, 37, 651-665.

Harris, M. (1987). Dynamic Economic Analysis. New York: Oxford University Press.

Harris, M. and Raviv, A. (1978). Some results on incentive contracts with applications to education and employment, health insurance and law enforcement. American Economic Review, 68, 20-30.

Harris, M. and Raviv, A. (1986). A sequential signalling model of convertible debt call policy. Journal of Finance, 41, 1263-1281.

Harris, M. and Townsend, R. (1981). Resource allocation with asymmetric information. Econometrica, 49, 33-64.

Harris, L. and Gurel, E. (1986). Price and volume effects associated with changes in the S&P 500: new evidence for the existence of price pressures. Journal of Finance, 41, 815-829.

Hartford, Sir T. (1969). Pricing a floatation. Journal of Business Finance, 1, 17-21.

Hausman, J. (1978). Specification tests in econometrics, Econometrica, 46, 1251-1271.

Hayes, S. (1971). Investment banking: power structure in flux. Harvard Business Review, 49, 136-152.

Healy, P. (1985). The effect of bonus schemes on accounting decision. Journal of Accounting and Economics, 7, 85-107.

Healy, P. and Palepu, K. (1990). Earnings and risk changes surrounding primary stock offers. Journal of Accounting Research, no volume number, 35-48.

Hegde, S. and Miller, R. (1989). Market-making in initial public offerings: an empirical analysis. Journal of Financial and Quantitative Analysis, 24, 75-90.

Heinkel, R. (1978). Dividend policy as a signal of firm value. from essays on financial markets with imperfect information. Unpublished doctoral dissertation, University of California Berkeley, CA.

Heinkel, R. (1981). Uncertain product quality: the market for lemons with an imperfect testing technology. Bell Journal of Economics, 12, 625-636.

Heinkel, R. and Schwartz, E. (1984). Rights versus underwrittenofferings: an asymmetric information approach. Unpublished manuscript, University of British Columbia, Vancouver.

Henderson, R. F. (1950). The New Issue Market and the Finance of Industry. New York: Cambridge University press.

Herman, E. (1981). Corporate Control, Corporate Power. New York: Cambridge University Press.

Hess, A. (1978). The riskless rate of interest and the market price of risk: a correction. Quarterly Journal of Economics, 93, 689-691.

Hess, A. and Bhagat, S. (1986). Size effects of seasoned stock issues: empirical evidence. Journal of Business, 59, 567-584.

Hess, A. and Frost, P. (1982). Tests for price effects of new issues of seasoned securities. Journal of Finance, 37, 11-26.

Hester, D. and Pierce, J. (1975). Bank Management and Portfolio Behavior. New Haven: Yale University Press.

Hite, G. and Owers, J. (1983). Security price reactions around corporate spin-off announcements. Journal of Financial Economics, 12, 409-436.

Hite, G. and Owers, J. (1985). Sale ivestitures: implications for buyers and sellers, Unpublished manuscript, Southern Methodist University, Dallas, TX.

Ho, T. and Stoll, H. (1980). On dealer markets under competition. Journal of Finance, May, 259-268.

Holderness, C. and Sheehan, D. (1985). Raiders or saviors? The evidence on six controversial investors. Journal of Financial Economics, 14, 555-579.

Holmstrom, B. (1979). Moral hazard and observability. Bell Journal of Economics, 10, 74-91.

Hopewell, M. and Kaufman, G. (1973). Bond price volatility and term to maturity: a generalized respecification. American Economic Review, September, 749-753.

Hughes, P. (1985). The Certification Role of the Investment Banker under Asymmetric Information. Unpublished paper, University of British Columbia, Vancouver.

Hughes, P. (1986). Signalling by direct disclosure under asymmetric information. Journal of Accounting and Economics, 8, 120-142.

Hwang, C. (1988). Signalling in new issue market. Unpublished doctoral dissertation, University of California Los Angles, CA.

Ibbotson, R. (1975). Price performance of common stock new issues. Journal of Financial Economics, 2, 235-272.

Ibbotson, R. (1982). Common stock new issues revisited (Working paper 84). University of Chicago Center for Research in Security Prices, Chicago, IL.

Ibbotson, R. and Jaffe, J. (1975). "Hot issue" markets. Journal of Finance, 30, 1027-1042.

Ibbotson, R., Sindelar, J. and Ritter, J. (1988). Initial public offerings. Journal of Applied Corporate Finance, 1, 37-45.

Ibbotson, R. and Ritter, J. (1993). Initial public offerings. In R. Jarrow, V. Maksimovic and W. Ziemba (Eds.). Handbooks of Operations Research and Management Science: Finance. Amsterdam: North-Holland.

Jacquillat, B. McDonald, J.. and Rolfo, J. (1978). French auctions of common stock: new issue, 1966-1974. Journal of Banking and Finance, 2 4, 305-322.

Jaffe. J. (1974). Special information and insider trading. Journal of Business, 47 3, 410-428.

Jaffe, J. (1974a). The effect of regulation changes on insider trading. Bell Journal of Economics and Management Science, 5 1, 93-122.

Jagannathan, R. (1984). Call options and the risk of underlying securities. Journal of Financial Economics, 13, 425-434.

Jain, P. (1985). The effect of voluntary sell-off announcements on shareholder wealth. Journal of Finance, 40, 209-224.

Jain, P. (1989). Equity issues and changes in expectations of earnings by financial analysts. Working paper, University of Pennsylvania.

James, C. and Weir, P. (1990). Borrowing relationships, intermediation, and the cost of issuing pubic securities. Journal of Financial Economics, 28, 149-172.

Jarque, C. and Bera, A. (1980). Efficient tests for normality, homoskedasticity and serial independence of regression residuals. Economics Letters, 6, 255-259.

Jarrow, R. and Rudd, A. (1983). Option Pricing. Homewood, IL: Irwin.

Jegadeesh, N., Weinstein, M. and Welch, I. (1993). An empirical investigation of IPO returns and subsequent equity offerings. Journal of Financial Economics, 34, 153-175.

Jenkinson, T. and Mayer, C. (1988). The privatization process in France and the UK. European Economic Review, 32, 482-490.

Jensen, M. and Meckling, W. (1976). Theory of the firm: managerial behavior agency costs and ownership structure, Journal of Financial Economics, 3, 305-360.

Jensen, M. and Ruback, R. (1983). The market for corporate control: the scientific evidence. Journal of Financial Economics, 11, 5-50.

Jensen, M. (1986). The agency cost of free cash flow, corporate finance, and takeovers. American Economic Review, 76, 323-329.

Johnson, N.. and Kotz, S. (1970). Distribution in Statistics: Continuous Univariate Distributions-I. Boston: Houghton Mifflin Company.

Johnson, J. and Miller, R. (1988). Investment banker prestige and the underpricing of initial public offerings. Financial Management, 17, 19-29.

Jog, V. and Riding, A. (1987). Underpricing in Canadian IPOs. Financial Analysis Journal, November-December, 48-55.

Jordan, B., Verbrugge, J. and Burns, R. (1988). Return to initial shareholders in savings institution conversions. Journal of Financial Research, 11, 125-136.

Kalay, A. and Sangchul, H. (1988). Bond convernants and new issues of equity: the case of a regulated industry. Working paper, University of Utah.

Kalay, A. and Shimrat, A. (1987). Firm value and seasoned equity issues: price pressure, wealth redistribution or negative information. Journal of Financial Economics, 19, 109-126.

Kamara, A. (1989). Liquity and short-term treasury yields. Working paper, University of Washington.

Kane, E. (1989). The S & L Insurance Mess: How Did It Happen? Washington, DC: Urban Institute Press.

Kane, E. and Unal, H. (1988). Market assessment of deposit- institution riskness. Journal of Financial Research, 1, 207-229.

Kane, E. (1990). Modeling structural and temporal variation in the market's valuation of banking firms. Journal of Finance, 45, 113-136.

Keeley, M. (1989). The stock price effects of bank holding company securities issuance. Federal Reserve Bank of San Francisco Economic Review, 3-19.

Keloharju, M. (1993). The winners' curve, legal liability, and the long-run price performance of initial public offerings in Finland. Journal of Financial Economics, 34, 251-277.

Keran, M. (1976). Inflation, regulation and utility stock prices.Bell Journal of Economics, Spring, 268-280.

Kessel, R. (1971). A study of the effects of competition in the tax-exempt bond market. Journal of Political Economy, 79, 706-738.

Kidwell. D., Marr, M. and Thompson, G. (1984). SEC Rule 415: the ultimate competitive bid. Journal of Financial and Quantitative Analysis, 19, 183-195.

Kim, D. and Santomero, A. (1988). Risk in banking and capital regulation. Journal of Finance, 43, 1219-1233.

Kim, E. and Schatzberg. J. (1985). Voluntary liquidation and stockholder returns. Unpublished manuscript, University of Michigan, Ann Arbor, MI.

Kim, Y. and Stulz, R. (1988). The Eurobond market and corporate financial policy: a test of the clientele hypothesis. Journal of Financial Economics, 22, 189-205.

King, B. (1966). Market and industry factors in stock price behavior. Journal of Business, 39, 139-190.

Klein, A. (1984). The effects of voluntary corporate divestitures on shareholders' wealth. Unpublished manuscript, University of Chicago, Chicago, IL.

Klein, B. and Leffier, K. (1981). The role of market forces in assuring contractual performance. Journal of Political Economy, 89, 615-641.

Kmenta, J. (1971). Elements of Econometrics. New York: Macmillan Company.

Koehn, M. and Santomero, A. (1980). Regulation of bank capital and portfolio risk. Journal of Finance, 35, 1235-1244.

Koh, F. and Walter, T. (1987). An empirical test of Rock's theory of the pricing of new issues. Working paper, National University of Singapore, Singapore.

Koh, F. and Walter, T. (1989). A direct test of Rock's model of the pricing of unseasoned issues. Journal of Financial Economics, 23, 251-272.

Kolodny, R. and Suhler, D. (1985). Changes in capital structure, new equity issues, and scale effects. Journal of Financial Research, 8, 127-136.

Korajczyk, R., Lucas, D. and McDonal, R. (1989). Understanding stock price behavior around the time of equity issues (Working paper 3170). National Bureau of Economic Research, Inc.

Korsvold, P. (1972). Price behavior of new debt issues and channelling efficiency in three European capital markets. Journal of Business Finance, 4, 1-9.

Korwar, A. (1982). The effect of new issues of equity. Unpublished doctoral dissertation, University of California Los Angles, CA.

Krasher, W. (1986). Stock price movements in response to stock issue under asymmetric information. Journal of Finance, 41, 93-105.

Kraus, A. and Stoll, H. (1972). Price impacts of block trading on the New York Stock Exchange. Journal of Finance, 27, 569-588.

Kraus, A. and Lizenberger, R. (1973). A state preference model of optimal financial leverage. Journal of Finance, 28, 911-922.

Kreps, D. and Wilson, R. (1982). Sequential equilibria. Econometrica, 50, 863-894.

Kyle, A. (1985). Continuous auctions and insider trading. Econometrica, 53, 1315-1335.

Lakonishok, J. and Vermaelen, T. (1986). Tax-induced trading around ex-dividend days. Journal of Financial Economics, 16, 287-319.

Lanen, W. and Thompson, R. (1988). Stock price reactions as surrogates for the net cash flow effects of corporate policy decisions in cross-sectional studies. Journal of Accounting and Economics, 10, 311-334.

Lauterbach, B. and Schultz, P. (1990). Pricing warrants: an empirical examination of the Black-Scholes model and its alternatives. Journal of Finance, 45, 1181-1209.

Lee, C. and Ready, M. (1991). Inferring trade direction from intraday data. Journal of Finance, 46, 733-746.

Lee, C., Shleifer, A. and Thaler, R. (1991). Investor sentiment and the closed end fund puzzle. Journal of Finance, 46, 75-109.

Leland, H. (1979). Quacks, lemons, and licensing: a theory of minimum quality standards. Journal of political Economy, 87, 1328-1346.

Leland, H. and Pyle, D. (1977). Informational asymmetries, financial structure and financial intermediation. Journal of Finance, 32, 371-387.

Levis, M. (1989). Stock market anomalies. Journal of Banking and Finance, September, 675-696.

Levis, M. (1990). The winner's curse problem, interest costs and the underpricing of initial public offerings. Economic Journal, 100, 76-89.

Levis, M. (1993). The long-run performance of initial public offerings: the UK experience 1980-1988. Financial Managment, 22, 28-41.

Lewis, S. (1984). Taking a Private Company Public. Jersey City, NJ: Scott Printing Corporation.

Lindsay, R. and Sametz, A. (1967). Financial Management. Homewood, Ill: Richard Irwin, Inc..

Linn, S. and Pinegar, M. (1985). The effect of issuing preferred stock on common stockholder wealth. Unpublished manuscript, University of Iowa, Iowa City, IA.

Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. Review of Economics and Statistics, XLVD, 13-37.

Lippman, S. and McCall, J. (1986). An operational measure of liquidity. American Economic Review, 76, 43-55.

Loderer, C. and Zimmermann, H. (1988). Stock offerings in a different institutional setting: the Swiss case, 1973-1983. Journal of Banking and Finance, 12, 353-378.

Loderer, C., Cooney, J. and Van Drunen, L. (1991). The price elasticity of demand for common stock. Journal of Finance, 46, 621-651.

Lederer, C., Sheehan, D. and Kadlec, G. (1990). The pricing of the second public offering. Working paper, Purdue University.

Logue, D. (1971). An empirical appraisal of the efficiency of the market for first public offerings of common stock. Unpublished doctoral dissertation, Cornell University, Ithaca, NY.

Logue, D. (1973a). On the pricing of unseasoned equity issues, 1965-69. Journal of Financial and Quantitative Analysis, 8, 91-104.

Logue, D. (1973b). Premia on unseasoned equity issues. Journal of Economics and Business, Spring-Summer, 133-141.

Logue, D. and Jarrow, R. (1978). Negotiation vs. competitive bidding in the sale of securities by public utilities. Financial Management, 7, 31-39.

Loss, J. (1961). Securities Regulation (2nd ed.). Boston: Little, Brown and Company.

Maddala, G. (1983). Limited-Dependent and Qualitative Variables in Econometrics. New York: Cambridge University Press.

Maksimovic, V. and Unal, H. (1993). Issue size choice and "under-pricing" in thrift mutual-to-stock conversions. The Journal of Finance, 48, 5, 1659-1692.

Mandeller, G. (1973). Return to stockholders from mergers. Unpublished doctoral dissertation, University of Chicago, Chicago, IL.

Mandeller, G. and Raviv, A. (1977). Investment baking: an economic analysis of optimal underwriting contracts. Journal of Finance, 32, 683-694.

Manne, H. (1969). Economic Policy and the Regulation of Corporate Securities. Washington, D.C.: American Enterprise Institute for Public Policy Research.

Markowitz, H. (1959). Portfolio Selection: Efficient Diversification of Investments. New York: John Wiley.

Marsh, P. (1979). Equity rights issues and the efficiency of the UK stock market. Journal of Finance, 34, 839-864.

Marsh, P. (1982). The choice between equity and debt: an empirical study. Journal of Finance, 37, 121-144.

Marskin, E. and Riley, J. (1980). Auctioning an indivisible object (Discussion paper 871). Harvard University, Kennedy School of Government, MA.

Masulis, R. (1980a). The effect of capital structure change on securities prices: a study of exchange offers. Journal of Financial Economics, 8, 139-178.

Masulis, R. (1980b). Stock repurchase by tender offer: an analysis of the causes of common stock price changes. Journal of Finance, 35, 305-319.

Masulis, R. (1983). The impact of capital structure change on firm value: some estimates. Journal of Finance, 38, 107-126.

Masulis, R. (1985). Changes in ownership structure: conversions of mutual savings and loans to stock charter. Unpublished manuscript, University of California Los Angles, CA.

Masulis, R. (1986). Second equity offerings: an empirical investigation. Journal of Finaicial Economics, 15, 91-118.

Masulis, R. (1987). Changes in ownership structure: conversion of mutual savings and loans to stock charter. Journal of Financial Economics, 18, 29-59.

Masulis, R. and Korwar, A. (1986). Seasoned equity offerings: an empirical investigation. Journal of Financial Economics, 15, 91-118.

Mayers, D. and Smith, C. (1982). On the corporate demand for insurance. Journal of Business, 55, 281-296.

Mayshar, J. (1978). Investor's time horizon and the inefficiency of capital markets. Quarterly Journal of Economics, 92, 187-208.

McConnell, J. and Sanger, G. (1984). A trading strategy for new listings on the NYSE. Financial Analysts Journal, Jan-Feb, 34-38.

McConnell, J. and Schlarbaum, G. (1981). Evidence on the impact of exchange offers on security prices: the case of income bonds. Journal of Business, 54, 63-83.

McDonnal, J. and Fisher, A. (1972). New issue stock price behavior. The Journal of Finance, 27, 97-102.

McDonnal, J. and Jacquillat, B. (1974). Pricing of initial equity issues: the French Sealed-Bid auction. Journal of Business, 47, 37-47.

McGoldrick, B. (1983). The great IPO battle. Institutional Investor, June, 61-64.

McStay, K.P. (1987). The efficiency of new issue markets. Unpublished doctoral dissertation, University of California Los Angles, CA.

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

Merritt, A. and Newbould, G. (1966). The comparative efficiency of methods of issue. The Manchester School.

Merritt, A., Howe, M. and Newbould. G. (1967). Equity issues and the London Capital Market. New York: Longmans.

Merton, R. (1973). Theory of rational option pricing. Bell Journal of Economics and Management Science, 4, 141-181.

Merton, R. (1973). An intertemporal capital asset pricing model. Econometrica, September, 867-887.

Merton, R. (1983). A simple model of capital market equilibrium with incomplete information. Journal of Finance, 42, 483-510.

Mester, L. (1987). Setting prices with auctions. Business Review Federal Reserve Bank of Philadelphia. Philadelphia, PA.

Michaely, R. and Shaw, W. (1992). The pricing of initial public offerings: tests of the adverse selection and signaling theories. Working paper, Cornell University, Ithaca, NY.

Mikkelson, W. (1981). Convertible calls and security returns. Journal of Financial Economics, 9, 237-264.

Mikkelson, W. and Partch, M. (1985). Stock price effects and costs of secondary distributions. Journal of Financial Economics, 14, 165-194.

Mikkelson, W. and Partch, M. (1986). Valuation effects of security offerings and the issuance process. Journal of Financial Economics, 15, 31-60.

Milgrom, P. and Roberts, J. (1986). price and advertising signals of product quality. Journal of Political Economy, 94, 796-821.

Miller, E. (1977a). Risk, uncertainty, and divergence of opinion. Journal of Finance, Sept, 1151-68.

Miller, M. (1977b). Debt and taxes, Journal of Finance, 32, 261-275.

Miller, M. and Modigliani, F. (1961). Dividend policy, growth, and the valuation of shares. Journal of Business, October, 441-433.

Miller, M. and Rock, K. (1985). Dividend policy under asymmetric information. Journal of Finance, 40, 1031-1051.

Miller, M. and Scholes, M. (1978). Dividends and taxes. Working paper, University of Chicago, Graduate School of Business, Chicago, IL.

Miller, R. and Reilly, F. (1987). An examination of mispricing, returns, and uncertainty for initial public offerings Financial Management, 16, 33-38.

Mirrlees, J. (1974). Notes on welfare economics, information, and uncertainty. In Balch, McFadden and Wu (Eds.). Essays on Economic Behavior under Uncertainty. Amsterdam: North Holland.

Modigliani, F. and Miller, M. (1958). The cost of capital, corporation finance and the theory of investment. The American Economic Review, 48 3, 261-297

Monroe, A. (January 15, 1986). Just like film stars Wall Streeters battle to get top billing. Wall Street Journal, 1.

Mood, A., Graybill, F. and Boes, D. (1974). Introduction to the Theory of Statistics (3rd ed.). New York: McGraw-Hill.

Moulton, J. (1987). New guidelines for bank capital: am attempt to reflect risk. Federal Reserve Bank of Philadelphia Business Review, July/August, 19-33.

Muscarella, C., Peavy, J. and Vetsuypens, M. (1992). Optimal exercise of the over-allotment option in IPOs. Financial Analysts Journal, May/June, 76-80.

Muscarella, C. and Vetsuypens, M. (1989). A simple test of Baron's model of IPO underpricing. Journal of Financial Economics, 24, 125-135.

Muscarella, C. and Vetsuypens, M. (1989). The underpricing of 'second' initial public offerings. Journal of financial Research, 12, 183-192.

Muth, F. (1960). Optimal properties of exponentially weighted forecasts of time series with permanent and transitory components. Journal of American Statistical Association, 55, 299.

Myers, S. and Majluf, N. (1984). Corporate financing and investment decisions when firms have information that investors do not have. Journal of Financial Economics, 13, 187-221.

Myerson, R. (1979). Incentive compatibility and the bargaining problem. Econometrica, 47, 61-74.

Myerson, R. (1981a). Optimal auction design. Mathematics of Operations Research, 6, 58-73.

Myerson, R. (1981b). Mechanism design by an informed principal (Discussion paper 481). Northwestern University, J.L. Kellog Graduate School of Management, Evanston, IL.

Nanad, V. (1988). Way Firms Go Public. Working paper, University of Chicago, Chicago, IL.

National Stock Summary, 1970-82. New York: National Quotation Bureau.

Nelson, P. (1974). Advertising as information. Journal of Political Economy, 81, 729-754.

Nelson, P. and Schwert, W. (1977). On testing the hypothesis that real rate of interest is constant. American Economic Review, June, 478-486.

Neuburger, B. and Hammond, C. (1974). A study of underwriters experience with unseasoned new issues. Journal of Financial and Quantitative Analysis, March, 165-77.

Neuburger, B. and LaChapelle. C. (1983). Unseasoned new issue price performance on three tiers: 1975-1980. Financial Management, Autumn, 23-28.

Neuberger, B. and Reilly, F. (1985). An analysis of daily returns from initial public offerings'. Paper presented at the Eastern finance Association Annual Meeting (April 1985 ).

Noreen, E. (1989). Computer Intensive Methods for Testing Hypotheses. Somerset, NJ: John Wiley and Sons.

Osborne, M. (1969). Periodic structure in the brownian motion of stock prices. In P. Cootner (Ed.). The Random Character of Stock Market Prices. Cambridge, MA: MIT Press.

Parson, J. and Raviv, A. (1985). Underpricing of seasoned issues. Jorunal of Financial Economics, 14, 377-397.

Peavy, J. (1990). Returns on initial public offerings of closed-end funds. Review of Financial Studies, 3, 695-708.

Polonchek, J., Slovin, M. and Sushka, M. (1989). Valuation effects of commercial bank securities offerings: a test of the information hypothesis. Journal of Banking and Finance, 13, 443-461.

Press, J. (1967). A compound events model for security prices. Journal of Business, 40, 317-35.

Pye, G. (1972). Capital gains, taxation, dividends, and capital budgeting. Quarterly Journal of Economics, 86, 226-242.

Pyle, D. (1972). Descriptive theories of financial institutions under uncertainty. Journal of Financial and Quantitative Analysis, 7 5, 2009-2029.

Rao, G. (1989). The relation between stock returns and earnings: a study of newly-public firms. Unpublished working paper, University of Illinois, IL.

Rasmusen, E. (1988). Mutual banks and stock banks. Journal of Law and Economics, 31, 395-421.

Reilly, F. (1967). Our misnamed stock price indicator. Kansas Business Review, 20, 4-9.

Reilly, F. (1973). Further evidence on short-run results of new issue investors. Journal of Financial and Quantitative Analysis, January, 73-80.

Reilly, F. (1977). New issues revisited. Financial Management, winter, 28-42.

Reilly, F. and Hatfield, K. (1969). Investor experience with new stock issues. Financial Analysts Journal, 25, 73-80.

Reinganum, M. (1981). Misspecification of capital asset pricing: empirical anomalies based on earnings' yields and market values. Journal of Financial Economics, 9, 19-24.

Riley, J. (1975). Competitive signalling. Journal of Economic Theory, 10, 175-186.

Riley, J. (1979). Informational equilibrium, Econometrica, 47, 331-359.

Riley, J. (1985). Competition and hidden knowledge. Journal of Political Economy, 93, 958-976.

Reints, W. and Vandenburg. P. (1975). The impact of change of trading location on a security's systematic risk. Journal of Financial and Quantitative Analysis, 10, 881-890.

De Ridder, A. (1986). Access to the stock market: an empirical study of the efficiency of the British and Swedish primary market. Stockholm: Federation of Swedish Industries.

Ritter, J. (1984a). The 'hot issue' market of 1980. Journal of Business, 57, 215-240.

Ritter, J. (1984b). Signalling and the valuation of unseasoned new issues: a comment. Journal of Finance, 39, 1231-1237.

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

Ritter, J. (1987b). A theory of investment banking contract choice. Unpublished working paper, University of Michigan, Ann Arbor, MI.

Ritter, J. (1988). The buying and selling behavior of individual investors at the turn of the year. Journal of Finance, 43, 701-717.

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

Robinson, J. (1969). The economics of imperfect competition (2nd ed.). New York: St. Martin's Press.

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

Rogers, E. (1963). The Diffusion of Innovation. Glencoe, IL: Free Press.

Rogers, E. and Shoemaker, F. (1973). Communication of Innovations. New York: Free Press.

Rogerson, W. (1983). Reputation and product quality. Bell Journal of Economics, 2, 508-516.

Roll, R. (1978). Ambiguity when performance is measured by the securities market line. Journal of Finance, 33, 1051-1069.

Roll, R. (1984). A simple implicit measure of the effective bid-ask spread in an efficient market. Journal of Finance, 39,1127-1139.

Rosenberg, B. and Marathe, V. (1975). The prediction of investment risk: systematic and residual risk. Proceedings of the Seminar on the Analysis of Security Prices (85-225). University of Chicago.

Ross, S. (1977). The determination of financial structure: the incentive-signalling approach. Bell Journal of Economics, 8, 23-40.

Rozeff, M. (1986). Tax loss selling: evidence from December stock returns and share shifts. Working paper, University of Iowa.

Ruud, J. (1990). Underpricing of initial offerings: goodwill, price shaving, or price support. Unpublished doctoral dissertation, Harvard University, Cambridge, MA.

Ruud, J. (1993). Underwriter price support and the IPO underpricing puzzle. Journal of Financial Economics, 34, 135-151.

Saari, C. (1977). The efficient capital market hypothesis, economic theory and the regulation of the securities industry. Stanford Law Review, 29, 1031-76.

Sahlman, W. (1990). The structure and governance of venture- capital organizations. Journal of Financial Economics, 27, 473-524.

Sanate Select Committee on Securities and Exchange (1974). Australian Securities Markets and Their Regulation, Part I. Canberra: Australian Government Printing Service.

Satterthwait, F. (1946). An approximate distribution of estimates of variance components. Biometrics Bulletin, 2, 110-14.

Schipper, K. and Smith, A. (1986). A comparison of equity carve- outs and seasoned equity offerings: share price effect and corporate restructuring. Journal of financial Economics, 15, 153-186.

Shleifer, A. (1986). Do demand curves for stock slope down? Journal of Finance, 41, 579-590.

Shleifer, A. (1986). Raising capital: theory and evidence. Midland Corporate Finance Journal, 4, 6-22.

Shleifer, A. and Summers. L. (1989). Crowds and prices: towards a theory of inefficient markets (CRSP working paper series 282). University of Chicago.

Schneider, C., Manko, J. and Kant, R. (1986). Going Public: Practice, procedure and consequences. Villanova Law Review, 27, 19-21.

Scholes, M. (1969). A Test of the Competitive Market Hypothesis: The Market for New Issues and Secondary Offerings. Unpublished doctoral dissertation, University of Chicago, IL.

Scholes, M. (1972). The market for securities: substitution versus price pressure and the effects of information on share price. Journal of Business, 45, 179-211.

Scholes, M. and Williams, J. (1977). Estimating betas from nonsynchronous data. Journal of Financial Economics, 5, 309-28.

Schultz, P. (1993). Unit initial public offerings. Journal of Financial Economics, 34, 199-229.

Schultz, P. and Zaman, M. (1994). Aftermarket support and under- pricing of initial public offerings. Journal of Financial Economics, 35, 199-219.

Schwert, W. (1983). Size and stock return, and other empirical regularities. Journal of Financial Economics, 12, 3-12.

Seligman, J. (1982). The Transformation of Wall Street. Boston: Houghton Fifflin Company.

Shapiro, C. (1983). Premiums for high quality products as returns to reputations. Quarterly Journal of Economics, 98, 659-679.

Sharpe, W. (1964). Capital asset prices: a theory of market equilibrium under conditions of risk. Journal of Finance, XIX, 425-442.

Shaw, D. (1971). The performance of primary common stock offerings: a Canadian comparison. Journal of Finance, September, 1101-1113.

Shleifer, A. and Vishny, R. (1986 ). Large shareholders and corporate control. Journal of Political Economy, 94, 461-488.

Simkowtiz, M. and Logue, D. (1972). Interdependent structure of security returns. Unpublished paper, Indiana University, IN.

Simon, C. (1989). The effect of the 1933 securities act on investor information and the performance of new issues. American Economic Review, 79, 295-318.

Smith, C. (1977). Alternative methods for raising capital: rights versus underwritten offers. Journal of Financial Economics, 5, 273-307.

Smith, C. (1979). Applications of option pricing analysis, in James L. Bicksler, ed. Handbook of Financial Economics, Amsterdam: North-Holland, 79-121.

Smith, C. and Watts, R. (1984). The structure of executive compensation contracts and the control of management. Working paper, University of Rochester, Rochester, NY.

Smith, C. (1986a). Investment baking and the capital acquisition process. Journal of Financial Economics, 15, 3-29.

Smith, C. (1986b). Raising capital: theory and evidence. Midland Corporate Finance Journal, 4 6-22.

Spence, A. (1973). Job market signalling. Quarterly Journal of Economics, 87, 355-374.

Spence, A. (1974). Competitive and optimal responses to signals: an analysis of efficiency and distribution. Journal of Economic Theory, 7 3, 296-332.

Spence, A. (1976). Information aspects of market structure: an introduction. Quarterly Journal of Economics, 90, 591-597.

Standard and Poor's. (1983). Security Price Index Record. New York: Standard and Poor's Corporation.

Standard and Poor's. 1977-82. Daily Stock Price Record for Over- the-Counter Stocks. New York: Standard and Poor's Corporation.

Stern, R. and Bornstein, P. (1985). Why new issues are lousy investments, Forbes, 136, 152-190.

Sternberg, T. (1989). Bilateral monopoly and the dynamic properties of initial public offerings. Unpublished working paper, Vanderbilt University, Nashville, TN.

Stickney, C. (1971). A study of the relationships of accounting principles and common stock prices of firms going public. Unpublished doctoral dissertation, Florida State University, FL.

Stigler, G. (1964). Public regulation of the security markets, Journal of Business, 37, 117-142.

Stiglitz, J. (1982). Information and capital markets. In W. Sharpe and C. Cootner (Eds.). Financial Markets: Essays in Honor of Paul Cootner. Englewood Cliffs, NJ: Pre ntice-Hall, Inc..

Stoll, H. (1976). The pricing of underwritten offerings of listed common stocks and the compensation of underwriters. Journal of Economics and Business, 28, 96-103.

Stoll, H. (1978). The pricing of security dealer services: an empirical study of NASDAQ stocks. Journal of Finance, September, 1153-1172.

Stoll, H. and Curley, A. (1970). Small business and new issues market for equities. Journal of Financial and Quantitative Analysis, September, 309-22.

Stoll, H. and Whaley, R. (1983). Transaction costs and the small firm effect. Journal of Financial Economics, 12, 57-79.

Stulz, R. (1988). Managerial control of voting rights: financial policies and the market for corporate control. Journal of Financial Economics, 20, 25-54.

Sudarsanam, S. (1992). Initial public offerings in the UK unlisted securities market. Unpublished manuscript, City University Business School, London.

Taggart, R. (1977). A model of corporate financing decisions., Journal of Finance, 32, 1467-1484.

Taggart, R. and Greenbaum, S. (1978). Bank capital and public regulation. Journal of Money, Credit, and Banking, 10, 158-169.

Talmor, E. (1981). Asymmetric information, signaling, and optimal corporate financial decisions. Journal of Financial and Quantitative Analysis, 41, 413-438.

Telsr, L. (1980). A theory of self-enforcing agreements. Journal of Business, 53, 27-44.

Theil, H. (1971). Principles of Econometrics. New York: John Wiley and Sons.

Tinic, S. (1988). Anatomy of initial public offerings of common stock. Journal of Finance, 43, 789-822.

Titman, S. and Truman, B. (1986). Information quality and the valuation of new issues. Journal of Accounting and Economics, 8, 159-172.

Treynor, J.L. (1961). Toward a theory of Market Value of Risk Assets. Unpublished manuscript.

Trueman, B. (1986). The relationship between the level of capital expenditures and firm value. Journal of Financial and Quantitative Analysis, 21 2, 115-129.

Uhlir, H. (1989). Going public in the FRC. In R. Guimaraes, B. Kingsman and S. Taylor (Eds.). A Reappraisal of the Efficiency of Financial Markets. New York: Springer-Verlag.

Uttal, B. (1986, July 21). Insider the deal that made Bill Gates $350,000,000. Fortune, 114, 23-33.

Van Horne, J. (1970). New listings and their price behavior. Journal of Finance, 25, 783-794.

Vaughan, G., Grinyer, P. and Birley, S. (1977). From Private to Public, Woodhead: Faulkner.

Vermaelen, T. (1981). Common stock repurchases and market signalling: an empirical study. Journal of Financial Economics, 9, 139-183.

Vermaelen, T. (1984). Repurchases tender offers, signaling, and managerial incentives. Journal of Financial and Quantitative Analysis, 19, 163-182.

Verrecchia, R. (1983). Discretionary disclosure. Journal of Accounting and Economics, 5, 179-194.

Vinson, C. (1970). Pricing practices in the primary convertible bond market. Quarterly Review of Economics and Business, 10, 47-60.

Vickrey, W. (1961). Counterspeculation, auctions and competitive sealed tenders. Journal of Finance, 16 1, 8-37.

Wansley, J. and Dhillon, U. (1989). Determinants of valuation effects for security offerings of commercial bank holding companies. Journal of Financial Research, 12, 217-234.

Warga, A. (1990). Bond returns, liquidity,a nd missing data. Working paper, Columbia University.

Warner, J. , Ross, W., and Wruck, K. (1988). Stock prices and top management changes. Journal of Financial Economics, 20, 461-492.

Weiss, A. (1983). A sorting-cum-learning model of education. Journal of Political Economy, 91, 420-442.

Weiss, K. (1989). The post-offering price performance of closed-end funds. Financial Management, 18, 57-67.

Weiss, K. (1990). Investor demand for initial public offerings and the relationship of the offer price to the preliminary file range. Unpublished working paper, University of Michigan., MI

Welch, I. (1989a). An empirical text of competing contract choice predictions of a winner's curse and a preselling model of IPO auctioning. Unpublished manuscript, University of Chicago, Chicago, IL.

Welch, I. (1989b). Seasoned offerings, imitation costs, and the underpricing of initial public offerings. Journal of Finance, 44, 421-449.

Welch, I. (1991a). Insider ownership and the decision to go public. Working paper, MIT, Cambridge, MA..

Welch, I. (1991b). An empirical examination of models of contract choice in initial public offerings. Journal of Financial and Quantitative Analysis, 26, 497-518.

Welch, I. (1992). Sequential sales, learning and cascades. Journal of Finance, 47, 695-732.

West, R.R. (1965). New issue concessions on municipal bonds: a case of monospony pricing. Journal of Business, 38, 135-148.

Westerfield, R. (1977). The distribution of common stock price changes: an application of transaction time and subordinated stochastic models. Journal of Financial and quantitative Analysis, 12, 743-65.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. Econometrica, 48, 817-838.

Williams, J. (1990). Savings Institutions: Mergers, Acquisitions and Conversions. New York: Law Journal Press.

Williams, J., Fleck, L. and Comizo, G. (1987). Mutual-to-stock conversions: new capitalization opportunities and post- conversion control and development. Legal Bulletin of the U.S. League of Savings Institutions, 237-317.

Wolf, G. (1984). The underpricing of unseasoned new issues of common stock. Unpublished doctoral dissertation, Virginia Polytechnic Institute and State University, VA.

Wolfson, N. (1976). Conflicts of Interest: Investment Banking. New York: The Twentieth Century Fund.

Wong, K. and Chiang, H. (1986). Pricing of new equity issues in Singapore. Asia Pacific Journal of Management, 4 1, 1-10.

Ying, L., Lewellen, W., Schlarbaum, G. and Lease, R. (1977). Stock exchange listings and securities returns. Journal of financial and Quantitative Analysis, 12, 415-432.

Zellner, A. (1962). An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias. Journal of the American Statistical Association, June, 348-368.

Zellner, A. (1966). On the Aggregation Problem: A New Approach to Troublesome Problem (Report 6628). University of Chicago, Center for Mathematical Studies in Business and Economics, IL.