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Underpricing of IPOs in New Zealand

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Abstract

This study provides further evidence of 'underpricing' of initial public offerings ("IPOs") in New Zealand. IPOs are frequently issued at prices substantially less than the market price on the first day of listing. Recent literature has widely documented such IPO 'underpricing' and adequately established that IPOs of common stock are underpriced.

This study examines the underpricing of 148 New Zealand IPOs between 1982 and 1997. The average market adjusted underpricing was 16.44% (median 10.05%), measured from offering date to list date, a level consistent with underpricing experienced in other markets,¹ but lower than previous studies of the New Zealand market.

This study makes two contributions to the existing IPO literature. First it performs a thorough univariate analysis of commonly cited reasons for underpricing with respect to the New Zealand market, and secondly it develops a multiple regression model. The model provides increased understanding of underpricing but due to a low R^2 , is not recommended to be used by market participants to predict future underpricing.

This study finds that New Zealand IPO underpricing for issues between 1982 and 1997 vary in a manner consistent with the model of Rock (1986), and the extension of this by Beatty and Ritter (1986). It also finds evidence of the relationship between IPO underpricing and underwriter reputation consistent with Carter and Manaster (1990) and the relationship between IPO underpricing and issue market conditions consistent with Ritter (1984) and Ibbotson, Sindelar and Ritter (1988). The model accounts for underwriter reputation, the market conditions that prevail during the issue, ex ante uncertainty of the issuing firm, and a signalling effect consistent with Rock's (1986) "winners' curse."

¹ Smith's (1986) survey of the equity IPO literature suggests that the degree of underpricing appears to exceed 15 %, on average.

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1. Introduction

1.1 Purpose of this Study

Initial public offerings (“IPOs”) play a crucial role in allocating resources in market economies. By accessing external sources of funds through an IPO, the new firm is able to acquire that capital necessary for firm growth and product innovation. Equity financing may be particularly attractive for “high risk” entrepreneurial ventures, and such enterprises represent an important motive force of economic development.

Because of the enormous importance of IPOs, understanding how IPOs work is a fundamental part of understanding financial markets generally. It is clear, however, that IPO markets involve unique features unobserved in any other important financial market. In particular, the recurring existence of large average first day returns to equity IPOs in the U.S. and other countries has long been recognised as an anomaly. Explaining these returns in a theoretically rigorous way is one of the primary problems of financial economics. While other studies have focussed on the long-run performance or the post-issue failure of new issues, no topic has gained more focus than the analysis of initial underpricing.

IPO underpricing, or high IPO initial return, is a phenomenon common to most stock markets [Loughran, Ritter and Rydqvist (1994)]. A common perception is that underpricing of IPOs is a contradiction to market efficiency and may hurt emerging firms trying to raise capital for expansion. Therefore it has spawned an extensive array of research attempting to explain this apparent financial anomaly. A number of underpricing theories have been proposed and tested against the data of various stock markets.

This study attempts to measure the size and characteristics of underpricing for IPOs in New Zealand between January 1982 and July 1997. It also attempts to use multivariate analysis to develop a model that market practitioners can use to predict the level of underpricing for an IPO, given the issue’s various characteristics.

Chapter 2 summarises previous studies and describes their initial conclusions. Chapter 3 outlines the methodology used to explain IPO pricing behaviour. The results presented in Chapter 4 include a univariate analysis of the various underpricing hypotheses and the development of a multivariate model. The univariate analysis provides a good understanding of the various underpricing hypotheses present in the New Zealand market before presenting the underpricing model later in the chapter. Chapter 5 summarises my conclusions.

1.2 Overview of Underpricing

Significant underpricing has been found to be a common feature for IPOs in New Zealand and other countries. Loughran, Ritter & Rydqvist (1993) provide a summary of 25 IPO studies where new issues were on average underpriced in the short run. Average underpricing of IPOs ranged from 4.2% in France to 66.0% in Malaysia. The amount of underpricing was found to be higher the more government intervention, the earlier in the process a fixed price was set and the riskier the firm going public. Long run returns were found to be lower for riskier firms going public and lower for high market returns in the following year.

IPO Underpricing in New Zealand

This study reviews the four published empirical studies of IPO underpricing in New Zealand: Vos and Cheung (1990 & 1993), Camp (1997), and Firth (1997).

None of these studies provides an in-depth analysis of the large extent of hypotheses proposed for the underpricing of IPOs with respect to the New Zealand market. Notwithstanding this, the most thorough analysis is Vos and Cheung's (1993). For the 149 firms studied from 1979 to 1991, the average market adjusted underpricing for IPOs is 28.77%, measured from offering date to list date. The abnormal return from the list date to one month hence is measured at -1.45%.

Vos and Cheung also develop a theoretical reputation model to explain underwriter reputation and underpricing in New Zealand. They measure the reputation for each underwriter as the sum of the market capitalisation of all issues underwritten, an approach this study also uses. The reputation of an underwriter was found to be positively correlated with the amount of underpricing for IPOs.

Vos and Cheung appear to have developed their theoretical model based on reputational factors observed in foreign markets. The non-existence of some factors in New Zealand and the unavailability of data mean they are unable to utilise actual market data to test the model. Hence, their model cannot be used to empirically explain or predict underpricing.

New Zealand IPO evidence from Vos and Cheung suggests the size of underpricing of any new issue is a factor of the reputation of the underwriter and the riskiness of the new issue. Results from Vos and Cheung's study indicate that it is likely that prestigious underwriters underprice their IPOs less than fringe underwriters because the IPO issues they underwrite are less risky, rather than because the potential threat of legal liabilities [Tinic (1989)] is less for prestigious underwriters. Vos and Cheung also partition their sample into the 1979-83 and 1984-91 sub-periods to test the effect of the change in Securities Regulations in September 1983. Vos and Cheung find this law change to have an insignificant effect on the underpricing of IPOs and conclude Tinic's (1988) legal insurance explanation is not supported by data in the New Zealand market.

Camp (1997) evaluates underpricing and short-term post-listing returns for New Zealand IPOs listed between 1983 and 1989. For the 162 firms studied, the average market adjusted underpricing for IPOs is 32.04%, measured from offering date to list date. The abnormal return from the list date to one month hence is measured at -4.76%.

Camp touches on the effect of listing in a "Hot" market [Ritter (1984)] but does not test this hypothesis because the majority of IPOs in his sample went public in a rising market - the bull market of the 1980s.

Camp develops a signalling model that remains unpublished at this stage.² Camp's analysis concludes that the level of offeror retention is the best signal of IPO underpricing in New Zealand. Camp's study also highlights the importance of the offer mechanism in terms of Rock's (1986) "winners' curse." Commentary on Camp's model is obviously restricted at this stage, but, although both the offer mechanism and offeror retention show significant results in this study's univariate analysis, only a proxy for offer mechanism is included in the multivariate model.

Firth (1997) also evaluates underpricing and long run performance of New Zealand IPOs listed between 1979 and 1987 using univariate analysis. For the 143 firms studied, the average market adjusted underpricing for IPOs is 25.87%, measured from offering date to list date. Firth does not empirically test any initial underpricing hypotheses due to his conclusion that previous empirical research on underpricing does not provide any significant explanation of first-day premiums. He therefore chooses to direct his analysis to the aftermarket performance of IPOs. He concludes that the analysis of longer-term returns can be used to see if the large initial returns really are evidence of underpricing or whether they are just evidence of investor irrationality.

Firth finds that IPOs lose 14% of their first day value after 3 years, which increases to 18% after 5 years. Firth concludes that the poor aftermarket performance of IPOs in New Zealand indicates that the initial prices on the first day of listing are set too high. Firth contends that firms do not underprice their share offerings, but investors and market makers unrealistically price the IPOs too high on the first day of listing, thereby giving the appearance of underpricing. Firth provides no explanation for this contention.

This study disagrees with Firth's conclusion on previous empirical research on underpricing. He has not analysed the hypotheses of previous research, just highlighted that the New Zealand market is consistent with international markets in the fact that underpricing has occurred.

² Camp's signalling model forms part of his PhD dissertation, which remains unpublished at this stage. I am thankful to Mr Camp for his description of his model and his thoughts on underpricing, which I gained through a number of conversations.

Firth's study discounts the significance of initial IPO returns too readily. Indeed, none of these studies provides an in-depth analysis of the various hypotheses postulated by previous studies to explain IPO underpricing. A number of questions remain unanswered. Only Vos and Cheung, who develop an underwriter reputation model and analyse the effect of IPO size, have done much more than provide a brief analysis of the initial underpricing level.

Therefore, there is scope for this study to develop an in-depth understanding of first day returns in New Zealand, which will not only test whether the New Zealand market is consistent with the findings in other international markets, but hopefully also provide an underpricing model which can be used by market participants to predict future underpricing. This study concentrates on initial IPO returns, as opposed to an analysis of long run performance performed by other studies [Camp (1997), Firth (1997)]. It makes sense from a vendor's perspective to concentrate this analysis on initial underpricing because it is this amount they are effectively "leaving on the table."

2. The Underpricing Phenomenon

2.1 Why Underprice?

Most empirical analyses point to several well-established facts about the characteristics of initial public offerings (“IPOs”) of stocks. While some of these facts are unsurprising (for example, IPOs are risky), several features of IPO performance are startling and require some explanation. By far the most striking empirical finding on IPOs is a consistent pattern of excess returns on the first day of trading. While such returns clearly undergo secular movements in extent, timing, and duration, Ibbotson’s (1975) findings of 11.4% average first day returns remains a plausible figure. Since aftermarket trading appears efficient, what factor or factors account for this extraordinary anomaly? When so much money is being “left on the table” one naturally asks why?

The large first day average returns to IPO equity securities caused considerable perplexity when they were first widely noted decades ago. Yet it was only with the development since the 1970s of sufficiently powerful analytical tools that “formal,” i.e. theoretically rigorous, explanations of IPO behaviour were proposed. Developments in game theory, financial economics, and information theory all contributed to the small “explosion” in theoretical analyses of IPOs observed since the early 1980s.

The formal or modern approach to modelling economic phenomena (such as IPO returns) is less a body of received theories than a discipline imposed on alleged explanations. Unlike earlier analyses of IPO returns that discussed such factors as “uncertainty” or “market ebullience,” the modern approach pays great attention to describing the informational environment in which economic participants make transactions.

Modern theories of IPO pricing offer various explanations for underpricing, and these explanations arise from important informational asymmetries between market participants. Since an IPO involves four relevant groups of participants - the issuing firm, the underwriting / distribution syndicate, the initial buyers, and the larger set of investors

in the secondary market - the information known to these various groups is critical. Although agents can have different information without any agent having unambiguously superior information, most models of IPO pricing typically assume one group has superior information on firm value. Other agents know this (although they do not know exactly what the information is) and behave accordingly. Further, everyone knows that everyone knows this, and so on ad infinitum.

The most widely discussed theories of IPO underpricing differ in their assumptions about which participants have superior information. Since offerings substantially vary in their sizes, terms, and market environments, it is perhaps unrealistic to expect that the informational assumptions in any one model will be applicable to all IPOs. Nevertheless, some assumptions are probably more realistic than others.

Although both the main modern and the “alternative” models of IPO pricing will be described in this chapter, it is useful at this initial stage to examine the informational assumptions one might make. First, one could assume that the issuer has better information on security value than do the underwriters or investors. This assumption, which is consistent with so much of the contemporary literature on the agency theory of the firm, gives rise to “signalling” models of underpricing. In these scenarios, underpricing is paradoxically used as a convincing claim of good firm value. Issuers recoup the money they gave away by benefiting from higher prices in a later, seasoned offering of additional shares.

Alternatively, underwriters/distributors can be assumed to possess information superior to the issuer. This assumption leads naturally to the “principal-agent” models of the IPO. The underwriter has valuable, private information on market demand. The issuer will wish to learn this information, yet must offer an incentive to the underwriter to truthfully reveal it. Further, the success of the offer depends not just on market conditions, but also on the underwriter’s effort which may itself be unobserved by the issuer. In order to secure truthful revelation of private information and encourage promotion efforts, the issuer may agree to a contract that leads to underpricing.

In contrast to the assumptions of the principal-agent and signalling models, the most important informational asymmetry may arise within a market group rather than between different groups. The assumption that, for example, a group of investors has superior information to that of other investors and the issuer, gives rise to the “adverse selection” model of underpricing. In this formulation, the existence of investors with superior information about issue value places uninformed investors at a disadvantage. Uninformed investors face competition for good shares, but have a high probability of obtaining bad shares due to the rationing mechanism applied to oversubscribed offerings. To induce the uninformed to participate in the IPO markets, shares must be underpriced on average.

It is common in most of IPO pricing to ignore the roles of market participants not directly concerned in the information asymmetry being assumed. Hence principal-agent models “ignore” investor behaviour, adverse selection models “ignore” the distinction between issuer and underwriter, etc. This modelling approach is necessary if the resulting analysis is to be tractable. However, issuers, investment bankers, distribution syndicates, and investors of various ability all undoubtedly have their roles to play.

This chapter represents a thorough review of the available literature on underpricing theory. The review is thorough because this study of underpricing in New Zealand is an empirical one and will thus test the existence and understanding of these theories, not develop my own.

This chapter is organised as follows. First, I examine adverse selection, principal-agent, and signalling theories of IPO underpricing. Next I briefly examine a set of “alternative” theories of underpricing. Finally, I address some of the models designed to explain other aspects of IPO behaviour.

2.1.1 Adverse Selection

Perhaps the best known and most studied explanation of IPO underpricing is the adverse selection mechanism first formally proposed by Rock (1986), and analysed by Beatty and Ritter (1986), Carter and Manaster (1990), Koh and Walter (1989), Ritter (1984), McStay (1992), and others.

Unlike many earlier explanations of IPO underpricing, the Rock mechanism provides a theoretically coherent model abundant in structure and predictions. Underpricing is viewed as a consequence of rational behaviour by issuing firms in an environment characterised by important informational asymmetries among potential investors. In particular, investors are differentiated by their levels of information about the true value of the issue, with “informed investors” having perfect (or superior) information, and “uninformed investors” knowing only the probability distribution from which this value is drawn. As a consequence of this asymmetry, informed investors compete with uninformed investors only for “good” issues, creating an adverse selection mechanism in which uninformed investors obtain shares in “bad” issues with greater probability. Hence, uninformed traders receive disproportionate levels of underpriced stocks. In order to induce uninformed investors to participate in the IPO market, issuers must “leave some money on the table” by underpricing as compensation for the uninformed.

Rock’s model focuses on three types of agents: an issuing firm, informed investors, and uninformed investors. The information structure implies, contrary to normal assumptions, that the issuing firm is not an “insider” as usually envisioned: the issuer knows no more about the value of the offering than do uninformed buyers. While this may seem unrealistic, the rationale for such an assumption is often given as disclosure requirements legally imposed on IPOs. By disclosing the financial condition of the firm, the proposed uses of the proceeds and the like, the firm has “shared” much of its relevant knowledge with the public. Thus, “uninformed” in this context is merely taken to mean “having less knowledge than informed investors.”

Underwriters and investment bankers³ play no role in Rock (1986), although later analyses based on Rock's idea have focused on this complication. There are several functions underwriters might perform. First, in a firm commitment offering, underwriter purchase of a block of shares provides insurance to the issuing firm. This is irrelevant in so far as the offering is made to effect a diversification of insiders' portfolios. Second, underwriters may have information useful in valuing the offering, and indeed principal-agent analyses such as that of Baron (1982) highlight this aspect. Third, certain selective methods of rationing shares in oversubscribed offerings, a traditional function of underwriters, may exacerbate or mitigate the degree of adverse selection, thereby increasing or reducing the level of underpricing required to induce uninformed investors to participate. Fourth, reputable underwriters may have the ability to "certify" the value of the issue, assuring uninformed potential buyers of its value and reducing or eliminating underpricing. Finally, underwriters may produce useful information on issue value through presale "solicitations of interest" aimed at knowledgeable investors, or by other means.

Rock envisions an enterprise obligated to making a firm commitment offering of shares to the public. Because the firm has information on share value inferior to the uninformed investors, the firm's behaviour doesn't tell investors anything. Analysis is restricted to a single, one shot offering: later sales of equity and/or debt are ruled out. The firm and all potential investors know each other's financial circumstances, preferences, numbers, and, by inference, behaviour.

I have summarised Rock's model in Appendix A.

³ Note that throughout this paper investment banker and underwriter can generally be used interchangeably because investment banks in the U.S. and New Zealand are generally also the underwriters of the issue. They therefore have the same reputation capital at stake.

Extensions of Rock's Work

Among the most important extensions of Rock's work are: (1) Beatty and Ritter's analysis of the roles of share value uncertainty and underwriter certification in underpricing; (2) Carter and Manaster's (1990) study of information gathering and underwriter reputation; and (3) Koh and Walter's (1989) direct test of Rock's equilibrium condition of normal returns to uninformed investors.

Beatty and Ritter (1986) argue that there is a positive relationship between the degree of uncertainty over share value and the extent of underpricing. In particular, as share values become more uncertain (more widely dispersed), the differing probabilities of getting good versus bad shares become more important since bad shares become even worse. This share value uncertainty is termed "ex ante uncertainty" to distinguish it from the more familiar systematic risk measured by Beta coefficients. Thus, adverse selection is a more serious problem for more highly speculative offerings. Given that offerings vary in their dispersions of values, however, why do owners of speculative firms underprice more when such a risky status might be initially concealed? Beatty and Ritter suggest that underwriters play a role in enforcing an equilibrium in which firms with highly uncertain values underprice more. The reputations of investment bankers are viewed as valuable assets which the underwriters wish to conserve and protect. Faced with a more speculative offering, underwriters' select lower offering prices in order to avoid later punishment by either investors (if they underprice too little) or issuing firms (if they underprice too much). Hence, one expects investment bankers who deviate from expected behaviour to lose market share, a proposition for which Beatty and Ritter offer some empirical support.

Carter and Manaster (1990) also emphasise the role of investment banker reputation, but additionally focus on information acquisition activities by investors. They argue that highly uncertain offerings trigger increases in information gathering efforts. This in turn increases the percentages of informed investors, worsening the adverse selection bias against uninformed investors. So long as such uninformed investors are still needed, the degree of underpricing must be greater. Since underpricing is not desirable to issuing firms, one would expect highly speculative firms to attempt to masquerade as low risk

issuers. Here, however, investment bankers have a role to play. In particular, a desire to protect their reputation induces prestigious underwriters to select only less speculative offerings. Hence, lower risk firms can try to signal their high quality by selecting prestigious underwriters who underprice less than their less prestigious competitors, and underwriter prestige should be a credible guarantee of limited informed trading. Carter and Manaster offer some empirical support for these claims.

As my previous discussion makes clear, a critical feature of Rock's model is the assumed "democratic" method of rationing shares when an offer is oversubscribed. In the U.S. and New Zealand it is frequently alleged that preferred or regular customers of distributing brokers are given preferential treatment in share allotments, and the laws in these countries allow greater latitude than do the regulations of many other countries. If underwriters allotted oversubscribed shares so that uninformed investors had better chances of obtaining allocations, adverse selection and underpricing would presumably be reduced. This idea has been used as the basis of several empirical tests of the Rock adverse selection mechanism, including those of Koh and Walter (1989) and McStay (1992), discussed in Section 2.2.2.

2.1.2 Principle – Agent

In the previous section I highlighted how Kevin Rock developed a theoretically consistent model of underpricing based on two primary assumptions: potential investors are differentially informed about the value of the issue, and the issuing firm/underwriter does not have useful private information on the issuing firm's prospects. While it is almost certainly true that some investors know more about an issue than others, much informal criticism of Rock's approach stems from the assumption that the issuing firm knows no more than do "uninformed" investors.

Since Ross's (1973) pioneering paper, utilisation of the "principal-agent" framework to analyse financial decision-making has become widespread. In analyses of this kind, an economic actor, called the "principal" hires an "agent" to transact some business for

them. The principal offers the agent a contract that specifies the agent's rewards, depending on some observable features of the outcome of the agent's actions. For example, sales representatives receive commissions based on their sales outcome. Typically, the basis for remuneration depends not just on the agent's efforts, but also on some random factors unobserved by one or both parties. The principal, who has all the bargaining power, cannot perfectly monitor the agent's behaviour. Further, the agent may have important information unavailable to the principal. The principal's problem, then, is to construct a contract that: (1) is at least minimally acceptable to the agent, (2) induces the agent to behave in the principal's interest, and (3) induces the agent to reveal or make appropriate use of any private information the agent might possess. Any such contract also will determine how risks are shared between the principal and agent. Such models are common in economics and financial research.

Baron (1982) applies principal-agent analysis to the IPO underpricing paradox. Unlike Rock's model, Baron assumes that the investment banker has information superior to that of the firm. This information may represent intimate knowledge of market conditions, investor contacts, or industry trends relevant to the issuer's financial prospects. The model has no role for dynamic competition among underwriters, nor for reputation building. Analysis focuses on the optimal behaviour of the issuing firm (the principal) and the investment banker (the agent) hired to execute the offering. Underwriting, which has an insurance benefit for the issuer, is ignored by assuming risk neutrality of both major participants.

The principal can choose from among three types of contracts. First, the investment bank can be used to distribute shares only, a "distribution contract." Second, the banker can be entirely bypassed with the principal selling shares directly to the public. Finally, the issuer can use a "delegation contract" in which the investment bank (indirectly) prices the offering and undertakes efforts to stimulate demand. Because Baron's principal-agent model is quite complex, my description in Appendix B will focus primarily on its underlying intuition.

Baron's Conclusions

Baron's general conclusions are as follows. First, if the issuer and banker had the same information on the state of the capital market, then a pure firm commitment contract would always be optimal. This occurs because by selling all the shares to the bank, the bank gains an incentive to promote the issue optimally: the bank will select its selling efforts to maximise the total net proceeds of the offering. The issuer receives a fixed payment in this case. If, however, the bank has superior information, then a distribution contract is likely to produce a moral hazard: the bank won't work hard enough. In this case the issuer may improve the returns by "delegating" pricing to the bank, ie, by utilising information from the bank to price the issue. The bank will earn a return for its special information. The example illustrates that this may result in underpricing. This conclusion can arise because by underpricing the shares, the issuer reduces the costs of assuring truthful advice from the banker.

Baron's model establishes that underpricing could arise because of a principal-agent relationship between the issuer and investment banker. It is important to recognise, however, the limitations of this analysis. First, the complexity of the model makes interpretation of some of the results difficult. Underpricing can occur, but such a result probably depends on some technical assumptions that are difficult to verify in practice. Second, principal-agent models implicitly rely on strong market structure assumptions. Surely competition among investment bankers would mitigate the moral hazard problems in an environment with reputation building? Finally, the information asymmetry used by Baron may not be a realistic description of many IPOs.

Underpricing can arise in Baron's model only when the investment banker has information superior to the issuer. If both had symmetric information, a firm commitment offering with no advising would arise in which underpricing would not occur and moral hazard would be absent. This fact allows for the test of Baron's model presented by Muscarella and Vetsuypens (1989), who examine initial excess return behaviour in IPOs of shares in the investment banks themselves. In these "self marketed IPOs," an investment bank "goes public" and promotes/distributes its own shares. Since here the principal and agent are the same firm, no information asymmetry should arise. Yet;

Muscarella and Vetsuypens find underpricing in these issues, a result not supportive of Baron's explanation.

I believe Baron's study does not address why issuers do not choose an investment banker with a record for pricing new issues more fully. That is, the issue of why underpricing is not eliminated by competition among investment bankers is not resolved. Also, Baron's hypothesis is not supported by empirical evidence.

2.1.3 Signalling

Unlike the assumptions made about informed/uniformed investors by adverse selection models, and the knowledgeable underwriter framework utilised in principal-agent theories of underpricing, signalling models propose that the issuing firm knows more about its prospects than do any other market participants. This specification is attractive because it coincides quite closely with an important area of modern finance theory: firm insiders know more than outsiders, leading to interesting strategic aspects in firm announcement, dividend, production, and investment behaviour. A vast amount of literature has arisen which analyses this sort of informational asymmetry.

An important feature of signalling models (which I have described in Appendix C) is that the behaviour that constitutes the signal occurs prior to offers being made for transactions. Hence, the informed participants move first. In contrast, "screening" models assume that the informed players act after, and in response to, offers made by the uninformed participant(s). This distinction is quite important for the possible existence of separating and pooling type equilibria. For institutional reasons that will become apparent below, underpricing models have uniformly adopted the signalling framework.

Application of the signalling mechanism to modelling an IPO relies on the idea that firms are differentiated by their values, and that these values, while unobserved by potential investors, are nevertheless known by the firms themselves. High value firms would obviously like to convince investors of their good quality in order to realise greater

proceeds from the sales of their securities. Yet, mere claims of high quality may be unconvincing. Hence, the firms need to find some action that is: (1) not too costly, and (2) unlikely to be imitated by low value firms seeking to mislead potential investors.

By applying the signalling idea to financial theory, Leland and Pyle (1977) argue that the level of retention of shares by the original owners can be a convincing signal of firm value to outsiders. Since the inside owners are presumably risk averse, and since their ownership in the firm may represent a large, undiversified risk, retaining some percentage of the shares (perhaps for later sale in a seasoned offering), is less costly for owners of high value firms than for owners of low value firms. If firm value may be (will be) revealed later, holding a large fraction of shares could make sense only for high value firm owners. In fact, the percentage of shares retained is fully informative in their model, allowing investors to perfectly calculate firm value V via the CAPM derived relationship:

$$V = (-b z / (1 + r)) [(\alpha + \ln(1 - \alpha))] + K \quad (1)$$

where V is firm value, r is the risk free interest rate, b is the coefficient of risk aversion in the entrepreneur's mean-variance utility function, K is capital outlay for the project, $Z = (\sigma_x^2 \sigma_M^2 - [\text{COV}(\bar{x}, \bar{M})]^2) / \sigma_M^2$ represents the specific risk of the project (equal to the variance of project returns σ_x^2 if such returns are uncorrelated with market returns), σ_M^2 is the variance of market returns, COV indicates the covariance between IPO returns \bar{x} and market returns \bar{M} , and α is the fraction of equity retained by the entrepreneur.

Leland and Pyle's results, while quite important, do not provide a theory of IPO underpricing. Since entrepreneur share retention is fully revealing, underpricing of shares need never occur. By observing α and inferring the relationship in equation (5), investors know exactly what firm value is; so there is no purpose in underpricing shares. Further, the Leland-Pyle signalling equilibrium is not automatic and requires additional conditions (eg., fewness of high value firms) to exist.

Leland and Pyle's insight leads to more or less contemporaneous application of the signalling mechanism by several authors. The papers of Allen and Faulhaber (1989),

Grinblatt and Hwang (1989), and Welch (1989) are especially notable: all seek to explain underpricing via signalling behaviours that are at least moderately similar to that described by Leland and Pyle (1977). Before I examine the logic underlying these contributions, several important points must be made.

First, one requirement for an action to be a signal is that it is observable. "Underpricing," per se, would appear to fail this test since it is not immediately clear that underpricing is always recognised as such. To be underpriced, a stock must have a known, "correct" price below which it is being sold. Yet, the "correct" price is presumably the information a high value firm would wish to signal. In any event, if pricing is to be a signal of value, one must explain how that signal can be recognised and interpreted by potential investors.

The argument above is not in itself really damning of signalling explanations of underpricing. First, it may in fact be possible for investors to recognise underpricing when they see it.

Second, underpricing may occur merely to facilitate some other form of signalling, such as the share retention procedure of Leland and Pyle, high dividends, retention of prestigious (ie., expensive) financial advisers, and the like. The second explanation suggests that underpricing could be merely a consequence of some signalling equilibrium and not an activity pursued for its own sake. How various signalling models deal with this issue probably constitutes an important distinction between them.

I note also that for any signalling model to make sense there must be some gains for high value issuers in signalling their values. To explain initial underpricing, the owners clearly must retain some shares that they plan to sell (at the high prices resulting from their signalling) in a later, seasoned offering. To put it plainly, shares are underpriced now to prove they are good so that later offerings command higher proceeds.

A final caveat must be applied to signalling explanations of underpricing. If a firm wishes to signal its value, it is not necessarily the case that underpricing is the best way. Given the enormous number of issuable claims, legal arrangements and other types of

observable behaviour open to firms, underpricing may be a feasible but overly expensive way to signal. The attractiveness of underpricing as a signal must depend on its immediate character.

Unlike “burning money” activities firms might use to signal, underpricing directly benefits investors and thus need not be monitored. Additionally, investor lawsuit risks may be reduced by underpricing [Tinic (1988)].

The signalling models of Allen and Faulhaber (1989), Grinblatt and Hwang (1989), Welch (1989), Nanda (1988), and others differ in some respects, and none seems inherently superior. Since the analysis of Grinblatt and Hwang is closest in form and notation to that of Leland and Pyle (1977), I have selected it for more extensive discussion in Appendix D.

The Grinblatt and Hwang signalling equilibrium works for the following reasons. When the project is valuable, the issuer wishes to demonstrate this. By issuing at a lower initial price, the issuer “proves” that the variance of the project is higher, which in turn “proves” that the issuer’s fractional holding α is especially costly. Since the issuer is risk averse, retaining more shares is unpleasant. Discounting the price is costly but is necessary to demonstrate the worth of the signal α . Hence, underpricing arises as a way of establishing the reliability of the other, more conventional signal, and is of no further independent significance. It is necessary to point out that for most signalling models there exists several equilibria, only some of which may be separating. Pooling equilibria, in which firms types cannot be distinguished by their actions, are also possible. Typically, the sort of equilibrium one expects to obtain may depend on various technical assumptions about parameter values in the model, and often criteria used to eliminate “bad” equilibria are insufficiently strong to produce a unique equilibrium. This would appear to be a defect in signalling explanations of underpricing, since all that one is usually able to show is that there are equilibria involving signalling and that these equilibria “may occur.” This supposed disadvantage may in some ways be an advantage. Empirical evidence suggests that the levels and frequency of underpricing vary significantly through time [Ibbotson and Jaffe (1975), Ritter (1984)]. Periods of very

high initial excess returns have been dubbed “Hot Issues” markets, and Allen and Faulhaber (1989) argue that exogenously driven changes in investment opportunities could cause changes in the sorts of equilibria one sees through time. “Hot Issues” markets are separating equilibria in which underpricing is widely employed as a signal. When market opportunities change, pooling equilibria involving no underpricing emerge. While such arguments are admittedly informal, signalling models, with their multiplicity of equilibria, may be more successful at explaining the secular behaviour of initial returns through time than competing models such as Rock (1986), which must rely on particular changes in the compositions of initial offerings. No real dynamic theory of “Hot Issues” markets has yet been proposed.

In summary, I believe the signalling hypothesis has neglected some fundamental issues. As in Rock’s model, the investment banker is only there to market and distribute the shares, with no decision-making role to play. This is unlikely since an investment banker also has reputation and financial capital at stake in underwriting an IPO. Moreover, to assume that the cost of signalling can be recouped from subsequent issues is to assume a certain degree of market inefficiency. That is, that subsequent shares of the firm can be sold at higher than expected prices than shares of equivalent risk. In addition, there is nothing to prevent the type of opportunistic behaviour of IPO investors which drives them to purchase the unseasoned shares in the first place. The fact that they have taken up the first issue for a discounted price does not guarantee they will pay a premium for the second issue, when there are equally appealing issues around for a lower price. There is no reason or obligation for the investor to compensate the firm for the signalling cost.

2.1.4 Alternative Theories

Although the adverse selection, principal-agent/moral hazard, and signalling models of IPO behaviour constitute the most widely discussed explanations of underpricing, a number of alternative theories have been proposed in the literature. Some of these alternative formulations - particularly the older ones - have not been formally developed to completion.

Competing alternative theories of underpricing include: the lawsuit avoidance theory of Tinic (1988), the presale information gathering model of Benveniste and Spindt (1989), the monopoly power argument, the “Cascades” theory of Welch (1992), the divergence of opinion argument of Miller (1977), and early views attributing underpricing to risk aversion of one sort or another. I briefly discuss these models below.

The Lawsuit Avoidance Theory

Tinic (1988) presents a simple theoretical model suggesting that underpricing may represent a form of insurance against lawsuits by disgruntled investors. The reputations of underwriters, which are temporally valuable assets, can be damaged by widely publicised legal troubles, and it would be surprising if investment banks did not take some precautions against this risk. Underpricing may reduce this risk since losses on shares then become less likely.

Formally, Tinic views the underwriters’ and issuers’ expected liability costs at time t , denoted $E [L_t]$, as equal to:

$$E [L_t] = f (P_t/P_0) \times g(P_0 - P_t) \quad (2)$$

where $f ()$ represents the probability of a settlement or judgement, P_t is the price at t , P_0 is the offer price, and $g ()$ is the expected damages given a lawsuit. Arguing that post offer relative prices may follow a lognormal distribution through time, Tinic shows that an offer price below the “true value” P of the shares reduces expected liabilities at all future dates.

To support this theory, Tinic examined underpricing levels in the U.S. before and after the Securities Act of 1933. This Act greatly expanded investor opportunities to pursue lawsuits against issuers and their underwriters. Tinic found increased underpricing since the Act, and noted that the current “multi-tiered” structure of the investment banking industry, in which prestigious firms restrict themselves to higher quality offerings, is a

post-1933 phenomenon. The results of pre- and post-1933 underpricing are important in themselves since such evidence appears inconsistent with, for example, a pure asymmetric information theory such as Rock (1986).

Tinic's argument, with his empirical results, is rather convincing for the sample of U.S. data. If legal insurance is the major cause of underpricing, one would expect similar results in a country like New Zealand, which has rules and regulations similar to those of the U.S.

Issuing firms in New Zealand were subject to a change in the securities regulations in 1983. Legislation increased the information requirements and legal liabilities for issuing firms. The critical date establishing the potential for 'legal insurance' underpricing thus becomes September 1, 1983. Vos and Cheung (1990, 1993) found this law change to have an insignificant effect on the underpricing of IPOs. A possible reason for this was, while the legal changes in New Zealand were significant, there was, under the Companies Act, legal recourse prior to the change in the law. The changes in the law in the U.S., therefore, may have been more significant.

Presale Information Gathering Model

Benveniste and Spindt (1989) offer a novel explanation of underpricing that emphasises the role of market information acquisition by investment bankers through "presale solicitations of interest." Prior to choosing price for a new issue, investment banks form a "roadshow" and make presentations to potential investors, brokers, and others. Indications of interest (or lack of interest) expressed by these investors may be valuable market signals useful in pricing the issue. As in Rock (1986), investors are of two types, "occasional" (ie., uninformed) and "regular" (or informed). Regular investors have valuable private signals on the worth of the issue. The difficulty, of course, is to provide investors who have favourable private information with an incentive to reveal it. Merely paying for good information triggers a flood of bogus "good" information. The incentive problem is solved, however, by giving preferential allocations of shares to regular investors with good news to share about the issuer's prospects. The system is maintained

by blackballing regular investors whose participation is unsatisfactory. Hence, underpricing is a way of compensating regular investors for revealing their private information.

The Benveniste and Spindt mechanism resembles a kind of auction and has several interesting empirical implications. First, when a bit of favourable news is relatively more valuable (i.e., leads to more favourable forecasts), underpricing levels rise. Extensive preselling should also be associated with greater underpricing. Finally, high interest in the offering should presage greater underpricing. Empirical support for some of these propositions appears in Beatty and Ritter (1986) and Welch (1989), though no formal test of this model has yet been undertaken.

The “Cascades” Theory

Welch (1992) offers a “dynamic” model of IPOs which alone among models of underpricing, recognises the sequential nature of share sales. While virtually all previous models implicitly assume that investor purchases of shares occur at a single point in time, Welch argues that later potential investors may learn from observing the behaviour of earlier ones. This idea is consistent with informal information about the initial marketing of some IPOs, and may offer an explanation of underpricing.

In Welch’s model, investors obtain private signals about the value or quality of the offered shares. Investors are approached and offered shares sequentially, with later investors being able to observe what earlier investors do. Yet the actions of early investors presumably reveal something about the information (signals) they possess. Buying by early investors may result in a later investor buying even when information is discouraging. Thus, the order in which investors are approached is important and can determine the success of the offering. When early selling activity results in later investors “ignoring” their private information, a chain reaction, termed a “cascade” by Welch, can ensue. These results are not dependent on the issuer having no inside information: issuers can receive private signals as well.

Welch's model explains underpricing even when the issuer is risk neutral. Because of the possibility of a cascade, issuers are induced to reduce initial prices. Further, issuers of good shares may price high enough that the offer can fail. Offers should succeed or fail quickly, and issuers may have an incentive to seek to limit investor-to-investor communication, or to perhaps bribe early potential investors.

Divergence of Opinion Argument

Miller (1977), suggests that IPO "underpricing" actually reflects the effects of investor divergence of opinion and rationing in oversubscribed offerings. In simple terms, suppose that investors place a wide variety of values on IPO shares. If rationing occurs in their sale, then in general there is no guarantee that those investors who place the highest values on the shares obtain their desired holdings. Once secondary market trading begins, the shares are reallocated towards the highest evaluators, and competition for shares leads to the first day price increase.

I believe this explanation of underpricing has not received general support for several reasons. First, the valuations investors place on shares are exogenous to the model: divergent beliefs are not explained. Second, such divergence would appear to imply that a "winners' curse" should always be observed. If those placing the highest values on securities have typically overestimated their values, then participating in securities markets must, on average, be a losing proposition: one buys only those shares for which one has overestimated their values. Investors should, in fact, recognise this and update or adjust their estimates of value accordingly. Whether divergence of opinion can explain first day returns when expectation formation is rational and consistent with market equilibrium remains an open question.

Market Power Theory

One of the oldest and most straightforward alternative explanations for underpricing, opposing Baron's (1982) principal-agent formulation, is the monopoly or market power theory. In this view, underwriting is regarded as cartelised, with investment bankers enjoying a privileged, monopoly position with respect to issuers. The banks exploit this power by forcing issuers to accept low offer prices. Investors who are profitable, regular customers of the underwriters and their affiliated brokers receive allocations and reap excess returns. The underwriters are willing to enforce this paradoxical cash give-a-way because they then recoup these excess returns in the form of high trading fees and commissions from favoured customers.

Several theoretical and empirical objections have been raised to the market power explanation of underpricing. First, why do underwriters engage in this complex charade of recycling profits from monopoly in one market (underwriting and distribution) into profits from another, perhaps competitive market (financial services)? Would it not be simpler and more efficient to merely take IPO profits directly in the form of higher fees and larger gross margins from underwriting? Second, if brokerage customers have access to numerous potential service providers, why don't they "take the money and run," enjoying excess IPO returns today and selecting a cheaper broker tomorrow? While such behaviour might lose them future favourable allocations in IPOs, that is irrelevant when service fees consume excess returns. If the fees do not consume all the excess returns, then the underwriter is giving money away merely to affect the recycling of monopoly profits.

On the empirical side, there is little evidence that underwriting and/or distribution exhibit monopoly. The competitive nature of underwriting has some confirmation [Hayes (1971), Hayes (1979)]. Evidence from antitrust suits do not support the notion of cartelisation. Finally, Beatty and Ritter (1986) produce strong evidence that excessive mispricing by underwriters is punished by a loss of market share. Hence, the monopoly power hypothesis has not proven to be a credible explanation of early excess returns.

Risk Aversion

I turn finally to the notion that excess returns merely reflect risk aversion on the part of one or another market participant. Note first that risk aversion is, in fact, an integral part of many conventional theories of underpricing: the Grinblatt and Hwang (1989) signalling model requires risk aversion on the part of the issuer, for example. I am interested here, though, in the idea that risk aversion is, by itself, a sufficient explanation.

It is important to distinguish between any underpricing motives created by risk aversion and the general IPO comparative static conclusion, found in almost all models, that increases in uncertainty over issue value are associated with greater underpricing. Increases in uncertainty can affect issuer and investor behaviour (even when all parties are risk neutral) by, for example, exacerbating adverse selection. Yet, this observation is quite distinct from the claim that risk aversion itself explains underpricing.

Early suggestions that risk aversion is a primary explanation of underpricing frequently assume market power on the part of underwriters: Bear and Curley (1975) is a representative example. Given a risk averse underwriter who has purchased a block of shares in a firm commitment offering, uncertainty over market reception of the issue may lead to underpricing as a form of insurance. It is certainly true that IPO share prices are risky and highly volatile. Whether this explanation is theoretically credible is doubtful, however. Since investors would typically risk only a tiny fraction of their collective wealth on the issue, it is unclear why they must be "bribed" by inflated returns to accept it. Further, whatever risks investors are being compensated for must be highly transitory: excess returns after the first day of trading are rare, and the long run performance of IPO securities is either average or poor. Further, while excess returns exist on average for IPOs, about half of all IPOs produce negative returns [Ibbotson (1975)], and only the extreme skewness of returns produces the overall positive result.

The great degree of underpricing exhibited by the smaller, more speculative best efforts offerings also undermines the risk aversion explanation. Unlike a firm commitment contract, a best efforts offering imposes much less risk on underwriters since they do not

commit themselves to purchase any shares. Since no insurance is provided to the issuer, underpricing would seem anomalous.

2.2 Testing Underpricing Theories

2.2.1 Introduction

The previous section provides an extensive review of the main theories so far proposed to explain underpricing. The primary “orthodox” explanations - adverse selection, principal-agent relationships, and signalling by issuers - all suggest that underpricing arises as a rational, equilibrium response to some important informational asymmetry between market participants. Additionally, some competing “alternative” explanations, such as those proposed by Benveniste and Spindt (1989) and Welch (1992), also propose differentially informed agents to explain the underpricing phenomenon. Given the large number of rigorous, well-specified explanations for underpricing, one wonders which explanation comes closest to the truth. This question is the subject of this section. This section also forms the background to the choice of variables to explain underpricing in New Zealand.

Throughout the IPO underpricing literature, authors have stated that testing theories of underpricing, and distinguishing between them, is a very difficult problem. Several factors contribute to the onerous nature of this enterprise. First, significant difficulty in distinguishing between theories arises due to the consistent agreement between many theories over the determinants of underpricing levels.

For example, the models of Rock (1986), Baron (1982), and Grinblatt and Hwang (1989), all suggest a positive relationship between the degree of investor uncertainty over issue value and the extent of underpricing. Hence, evidence of a positive correlation between initial returns and some value uncertainty proxies (such as offer size), while interesting, does not allow the researcher to distinguish between competing theories.

A second difficulty for empirical testing of underpricing theories arises from the nature of the models themselves. In virtually all cases, asymmetric information is not directly observable, but instead must be inferred from certain observable magnitudes available for study. This implies that any test is likely to involve an additional, untested assumption: the variables selected to represent the level of informational asymmetry must successfully do so if the test is to be valid, or else one must find implications of the theories which imply certain distinct relationships between observable variables.

As a result of the complications described above, empirical testing of underpricing theories has followed two dissimilar paths. The first path attempts to find proxy variables for important model characteristics such as the level of informed trading in an IPO. The success of such an approach clearly depends on the success in selecting proxies. A second path eschews proxy variables and restricts analysis to tests of certain equilibrium conditions between observable magnitudes implied by the models. While this second approach is probably methodologically preferable, research is by definition limited to evaluation of only a small subset of most model predictions. In a general sense, both approaches are necessary and, one hopes, ultimately complementary.

Prior to reviewing empirical tests of specific theoretical models, I turn first to a brief treatment of a body of literature that attempts to evaluate the link between share value uncertainty and the degree of underpricing. As noted above, the evaluation of this link does not provide a useful way to distinguish between various theories: almost all theories suggest that stocks with very uncertain values will be more underpriced on average. It appears probable, in fact, that this uncertainty-underpricing connection is itself a stylised fact about IPOs which is used in guiding theoretical model building. This link is nevertheless of some independent significance and has served as a focus of much early empirical research on IPO underpricing.

Among the papers that have examined the link between value uncertainty and underpricing are: Ederington (1974), Bear and Curley (1975), Beatty and Ritter (1986), Miller and Reilly (1987), Johnson and Miller (1988), and Carter (1992). Almost all such analyses utilise a “proxy” approach to measuring value uncertainty. A wide range of such proxies has been proposed, including aftermarket price volatility, issue size, and the

number of uses of offer proceeds given in the prospectus. Presumably aftermarket price volatility, small issue size, and numerous uses for offer proceeds imply greater uncertainty over value, although such a link is not explicitly drawn. Further, the distinction between risk and value uncertainty is often not formally made.

With these above-mentioned caveats, empirical analyses have uniformly shown that greater uncertainty over values is associated with greater levels of underpricing. This result is robust both to changes in the historical eras selected for analysis and to changes in the proxies used to represent this uncertainty. While this result constitutes an important fact about IPOs, a positive correlation between value uncertainty and underpricing is a consequence of most theoretical models, and therefore does not allow us to distinguish between them.

2.2.2 Tests of Underpricing Theories

I now turn to a brief review of the main empirical tests of the IPO underpricing models described in the previous chapter. For reasons of space and consistency, I will limit my investigation to those empirical papers that most directly address the problems of testing the models. As will be seen, evidence for most theoretical models is mixed, and considerable investigation remains to be done.

Adverse Selection

As noted in the previous section, Kevin Rock (1986) suggests that underpricing arises as a compensation device for uninformed traders. The existence of informed traders implies that uninformed traders receive shares in IPOs with greater frequency when the shares are “bad” (overpriced) than when they are “good.” In order to attract the uninformed to the market, shares must be underpriced on average.

Rock’s model has several implications for market performance that facilitate testing using both the “proxy” and “equilibrium condition among observable variables”

approaches. First, the level of informed trading should be positively correlated with underpricing. Any device that guarantees reduced informed trading should increase prices and reduce initial returns. Second, the method by which shares in oversubscribed offerings are rationed is critically important, and should be related to underpricing in a way to be explained below. Most importantly, equilibrium implies only normal returns to uninformed traders. Informed traders - who bid only on underpriced issues - presumably make (potentially large) profits, although these profits may, in a broader view, serve as compensation for the costs of becoming informed (Beatty and Ritter, (1986)). In addition to these features, the Rock model has a number of other equilibrium implications that are not obviously useable for testing purposes.

The role of informed trading in determining the level of underpricing has been the basis for several "proxy"-style tests of Rock's mechanism. The "bias" against uninformed traders arises from two intertwined features: the uninformed have a bigger chance of receiving bad shares (since the informed do not bid on them), and the rationing rule used to allocate shares in oversubscribed offerings gives inadequate, or no, preference to uninformed traders. Rock's original analysis assumed purely random rationing independent of investor type and order size. Such purely random schemes do not correspond very closely with actual rationing practices, to be described below. In particular, though, the role of underwriters and their syndicates in distributing issues may be important in determining the level of underpricing because the way shares are rationed directly affects the probabilities with which various types of investors receive allocations. Further, characteristics of the underwriters may convey information to investors on the extent of informed trading.

Several studies have evaluated the roles of underwriter characteristics and allocation rules in determining the levels of underpricing. Unfortunately, underwriter characteristics, such as "prestige," may signal information on both the level of informed trading and unobserved IPO security characteristics such as "riskiness." It seems more plausible that underwriter prestige signals security quality rather than the level of informed trading. In any event, Beatty and Ritter (1986), Carter (1992), and Carter and Manaster (1990), offer interesting insights on this issue. In general, high prestige underwriters underprice their securities less than other underwriters.

McStay (1992) utilises British data to evaluate the Rock model. Adopting the distributional analysis of Kenny and Klein (1983), McStay argues that investment banks reduce underpricing by preferentially allocating shares to “uninformed” customers. These uninformed traders are assumed to be active private investors having close relationships with distributing brokers. In the UK, IPOs are of two main types: the “offer for sale” and the “placement.” The former impose strict random allocation rules similar to the assumptions made by Rock (1986), while the latter resemble U.S. IPOs in allowing the underwriter wide discretion in distribution. Hence, if the preferential allocation notion is correct, one expects less underpricing in placements than in offers for sale. Of course, offers for sale and placements differ in other ways (eg., in the allowable minimum sizes of the offers); so an uncritical comparison is not useful.

McStay attempts to estimate the levels of uninformed demand by noting that, in general, the demand for “bad” IPOs must primarily consist of uninformed buyers. Technical complications aside, any valid estimates of uninformed demands should allow one to construct “theoretical” portfolios for uninformed traders. The question then becomes “is the expected return to the uninformed trader zero?” McStay presents some evidence in support of this proposition, although considerable caution should be applied to these results for statistical reasons discussed by McStay.

Koh and Walter (1989) and Lee, Taylor and Walter (1996a) also turn to markets outside the U.S. in an effort to evaluate Rock’s model. In particular, Singapore imposes strict rationing rules on oversubscribed offerings. Further, rationing is public: the probabilities of getting shares are known. Koh and Walter argue that, if one weights share allocations by rationing probabilities (assuming the uninformed invest in all IPOs, being unable to tell the good from the bad), one should get a portfolio offering only a normal return.

Koh and Walter’s analysis provides perhaps the strongest statistical evidence in support of the Rock model. Specifically, they find that: (1) expected returns to the uninformed portfolio are normal; (2) the greater the degree of over-subscription of the offering, the greater the level of initial returns; and (3) results (1) and (2) are robust to various partitions of the data set based on issue and/or underwriter sizes. This is especially strong evidence in support of Rock’s model because it seems highly unlikely that the returns to

a portfolio of IPO securities, constructed along the lines described above, would exhibit zero excess returns unless Rock were right.

Principal – Agent

The principal-agent analysis of Baron (1982) suggests that underpricing occurs due to attempts by the issuer to motivate the agent (underwriter) both to expend effort on sales promotion activities, and to reveal private information valuable to the issuer. Thus, underpricing arises in this framework because the investment bank has private information unavailable to the issuing firm.

Baron's analysis focuses on the nature of the optimal contact between the issuing firm and the underwriter. The basic informational asymmetry assumed by Baron - bankers know more than issuers - can be exploited to produce a clever test of Baron's insight. In particular, investment banks sometimes "go public" in an IPO which they "self-market." In such cases there is no separation of issuer and underwriter; so no informational asymmetry of Baron's type can arise. Hence, if Baron is correct, one would expect zero systematic underpricing in these special IPOs. Muscarella and Vetsuypens (1989) use this approach in evaluating Baron's model. They examine 38 IPOs of investment banks that participated in the distributions of their own securities over the years 1970-1987. Muscarella and Vetsuypens find that, contrary to the "predictions" of the Baron framework, these IPOs exhibit statistically significant underpricing, with first day returns of around 7% on average. Further, the prestige of the investment banks appears insignificant in explaining the degree of underpricing. While the Muscarella and Vetsuypens data set is small, their results cast considerable doubt on the importance of issuer/underwriter information asymmetries in explaining underpricing.

The idea that underpricing arises from attempts by issuers (underwriters) to signal their private information on the values of shares is developed in theoretical models by Allen and Faulhaber (1989), Grinblatt and Hwang (1989), Welch (1989), and others. The logic here is that issuers know more about share value than do any other market participants. Issuers with high value projects would like to prove this to investors. Underpricing can

either be a signal of value, or may establish the reliability of some more traditional signal such as share retention.

Testing “signalling models” is a difficult proposition. First, there are a number of such models, and these models are not strictly comparable with one another. The order of moves, the informational environment, and other critical theoretical characteristics, differ between models. Second, most signalling models admit multiple equilibria, some of which involve “pooling” (no signalling), so one might say that signalling models explain “too much” to be confidently tested. Finally, while the nature of the asymmetric information assumed in signalling models is quite modern in spirit, the distinctive predictions of signalling models usually can be tested only by evaluation of both initial and longer holding period returns. Since underpricing shares is costly, signalling makes sense only if the issuer retains shares for later sale in a seasoned offering. It is returns from these later sales that “justify” the earlier signalling. Yet many IPOs are one shot: no further sales of shares are made. For these and other reasons, statistical tests of signalling models of underpricing are few and far between.

The general idea that informed insiders signal firm value characteristics to outside investors is widely known and frequently tested in the formal literature of finance. IPOs, due to their special characteristics, afford a natural experiment for evaluating the signalling idea. Downes and Heinkel (1982) provide an important early application of the share retention signal suggested by Leland and Pyle (1977) to a sample of 297 larger, U.S. IPOs for the period 1965-1969. Downes and Heinkel regress firm market values on the offered value of the IPOs and α , the proportion of shares retained by the owners. Several estimation techniques and data formulations are utilised, and the role of dividends as value signals is also investigated. Downes and Heinkel find that share retention levels are significantly and positively associated with firm value in the manner suggested by Leland and Pyle (1977).

Market Conditions

Ritter (1984) explores the underpricing of IPOs in “hot issue” and “cold issue” markets by expanding Rock’s risk-return model. Risk is measured by the annual sales of the issuing firm and return is the amount of underpricing for any new issue.

Ritter found in a hot issue period, a large proportion of IPOs were high risk with average underpricing of 48.4%. In other periods, a large proportion of IPOs were low risk with average underpricing of 16.3%. However, Ritter finds the relationship between risk and return cannot explain the hot market of 1980 for non-natural resource issues. There is little evidence that a hot market existed for non-natural resource issues in 1980, thus, the significant underpricing in this time is “consistent with underwriters exploiting start up natural resource firms during the oil and gas boom that occurred during 1980.”⁴ Ritter further concludes that this situation is inherently unstable and not surprisingly has not continued.

Ibbotson, Sindelar and Ritter (1988) point to a recurring pattern of alternating “hot” and “cold” new issue markets in the U.S. During a bullish period and heavy volume trading, new issues are commonly underpriced by significantly more than new issues in cold markets. Ibbotson, Sindelar and Ritter found that the cyclical nature of underpricing allows predictions of the next months average initial return to be made based on this month’s return. Ibbotson, Sindelar and Ritter also found that high levels of underpricing led to high volumes of IPOs in 6 to 12 months. Following these observations, Ibbotson, Sindelar and Ritter suggest investors should subscribe to new issues in the early part of the hot period, when IPOs are most underpriced. Issuers should refrain from issuing shares at this time, but should wait until the period of heavy volume that follows hot issue markets. Ibbotson, Sindelar and Ritter propose that issuers get the highest price for their shares at a time where the market is still willing to pay high multiples for unseasoned new issues.

⁴ Ritter, J. “The ‘Hot Issue’ Market of 1980,” *The Journal of Business* (Vol. 57, No. 2, 1984): 239.

Another explanation for the effect of market conditions on underpricing is provided by Aggarwal and Rivoli (1990), who explain the inefficiency of the short-term post-listing market for IPOs with their “fads” argument. They believe firms tend to go public during periods when investors are (irrationally) optimistic about the value of IPO securities and, as a result, the market overvalues IPO securities on the day they list. They found initial prices for IPO securities are not efficient. As price exceeds “true value” informed investors sell. The price of the security will then move (downwards) into equilibrium and a negative return is an inevitable consequence.

Share Retention – Market Value Linkage

Ritter (1984) also offers a useful comment on the Downes and Heinkel (1982) methodology by proposing stronger empirical tests and competing alternative hypotheses for the share retention - market value linkage. Noting that share retention may be positively correlated with firm market value for several largely unrelated reasons, Ritter provides additional empirical evidence using a sample of 559 U.S. IPOs for the period 1965-1973. Ritter’s findings cast doubt on the Downes and Heinkel results: the percentage of shares retained is not seen as a significant determinant of firm market value. Indeed, Ritter’s results appear more supportive of an “agency” interpretation for this linkage in which managerial neglect alters firm values.

Information Asymmetry

Chemmanur (1993) explores the hypothesis that underpricing generates publicity about the issuing firm that induces investors to learn more about the firm. This leads to a run-up in the secondary market share price that is in the best interests of the firm going public. Chemmanur’s model assumes insiders of the firm hold quality information about the firm going public. Outsiders may acquire information at a cost and the insiders will be motivated to maximise outsider information so this will be reflected in the secondary market of the new issue. Information production is costly to the outsider so only a lower IPO price may induce outsiders to seek information.

Signalling

It is important to recognise that the Leland and Pyle (1977) signalling hypothesis does not explain IPO security underpricing. Extensions of the Leland and Pyle framework to the underpricing problem, eg., Grinblatt and Hwang (1989), allow one to derive a set of potentially testable implications.

Grinblatt and Hwang (1989) point out that empirical results offered by Ibbotson (1975), Ibbotson and Jaffe (1975), Beatty and Ritter (1986), Chalk and Peavy (1987), Ibbotson, Sindelar and Ritter (1988), and Hwang (1988), often tend to confirm at least some of their theoretical findings, although none of these empirical papers is designed as an out-and-out test of their model.

Lawsuit Avoidance

The lawsuit avoidance theory of Tinic (1988) has been the subject of two empirical evaluations in the U.S., one offered by Tinic and the other by Welch (1991). Tinic noted that the U.S. Securities Act of 1933 greatly expanded the opportunities for disgruntled investors to pursue lawsuits against the underwriters of underperforming IPOs. Tinic utilised data from IPOs for the years 1923-1930 and 1966-1971 to evaluate excess return behaviour. Tinic found that:

- (i) Underpricing was much greater in the later years (post 1933);
- (ii) Prior to the Securities Act of 1933, there was no relationship between underpricing and investment banker reputation;
- (iii) After 1933, prestigious underwriters began to shun highly speculative issues, leading to the currently observed “segmented” market in underwriting services.

These results provide at least approximate support to Tinic’s theory, although numerous institutional changes in the financial markets between the sample years studied by Tinic makes it difficult to give unqualified support to Tinic’s conclusions.

Issuing firms in New Zealand were subject to a change in the securities regulations in 1983. Vos and Cheung (1991,1993) found this law change to have an insignificant effect on the level of underpricing of IPOs.

Risk Aversion

Beatty and Ritter (1986) tested two propositions. Firstly, that the greater the ex ante uncertainty of the value of an issue, the greater will be the expected underpricing. Beatty and Ritter found a positive relationship between ex ante uncertainty and the size of underpricing. Ex ante uncertainty was proxied by the number of uses for the proceeds listed in the prospectus and by the inverse of the gross proceeds. This implies that if the level of uncertainty is an endogenous determinant of the level of underpricing it would be in the issuer's advantage to voluntarily disclose information.

Underwriter Reputation

Beatty and Ritter's second proposition relates the reputation capital of the underwriter with the ex ante uncertainty of the offering. Beatty and Ritter propose that underwriters whose offerings have initial returns that are inconsistent with the ex ante uncertainty of their value will lose subsequent market share. Any investment bank that cheats by pricing offerings either too high, or too low will lose customers, both potential issuers and investors. Beatty and Ritter found three conditions necessary for investment bankers to continue underpricing. These are that

- (i) underwriters are not perfect forecasters of the after market price
- (ii) each underwriter must have non-salvageable reputation capital at stake on which it is earning a return and

(iii) any underwriter that cheats, by pricing “off the line” must lose clients.⁵

Empirical evidence suggests that underwriters who do price “off the line” in one sub period lose clients in the next sub period. Beatty and Ritter use this evidence to support the argument that it is the investment bankers that enforce the underpricing equilibrium.

I agree with Beatty and Ritter’s argument for a large economy like the U.S. However, Vos and Cheung’s (1993) study of the New Zealand IPO market indicates that although there are differences in the reputation capital of underwriters in New Zealand, the difference is much less distinct than in other larger economies. The expected benefit (in the form of extra commission income) of pricing large issues more fully may well overwhelm any expected cost of a damaged reputation. Therefore, one would expect to find a more prominent reputation effect in a sample of IPOs in the U.S. since there are more “blue chip” underwriters with huge reputation capital at stake.

Contract Choice / Offer Mechanism

The contract choice and offer mechanism characteristics are currently the most widely studied proxies for IPO underpricing [Lee, Taylor and Walter (1996a, 1996b), Camp (1997), Loughran, Ritter and Rydqvist (1993), Benveniste and Wilhelm (1997)].

Welch (1991) provides an interesting empirical examination of some common contract provisions observed in IPOs. Best efforts offerings frequently incorporate “minimum sales constraints” that allow withdrawal of the offer if it is poorly received. In firm

⁵ Beatty and Ritter define a line measuring the relationship between predicted average percentage return (horizontal axis) and actual average percentage return (vertical axis). This line has a slope of one and an intercept of zero. Predicted average percentage returns are found by regressing the log (1+ the number of uses of proceeds) and reciprocal of gross proceeds on the initial return. All IPOs should lie along this line if every investment banking firm enforced the underpricing equilibrium with no error.

commitment offerings,⁶ over-allotment options allow the underwriter to sell additional shares when demand is sufficiently robust. Welch's main purpose was to examine the use of these contract provisions in the theoretical frameworks provided by Benveniste and Spindt (1989) and Rock (1986); yet Welch provided some evidence of the Tinic (1988) lawsuit avoidance hypothesis. In particular, Welch found that "riskier" firm commitment offerings were associated with greater underwriter compensation. Yet, the number of risk factors for which underwriters can be held liable (listed on the prospectus) is unrelated to underpricing levels. However, the Tinic theory suggests that underpricing should rise as these legal liability risk factors increase in number. Thus, one concludes that underwriters are compensated directly for risky offerings, not indirectly through the insurance explicit in underpricing.

Although the proxy used for underwriter liability risk is almost surely imperfect, Welch's results are not supportive of Tinic's theory of underpricing.

Welch had as a primary purpose an examination of the underwriter preselling model of Benveniste and Spindt (1989) and Benveniste and Wilhelm (1990). Benveniste and Spindt use game theory to model preselling activities by underwriters. When a potential investor has favourable private information on the offering's prospects, the investor must be given a proper incentive to reveal it since such information can lead to higher initial prices. In order to secure truthful reporting by potential investors, the underwriter designs a "revelation mechanism" that induces investors with favourable information to share their insight with the underwriter. This is achieved by offering preferential allocations of shares to investors reporting good information. Such a scheme works because lying (eg., reporting discouraging news when indications are favourable) reduces the chances of getting an allocation of shares which are probably good. Repeated

⁶ It is important to note that firm commitment contracts in the U.S. have the offer price set after information about the state of demand is collected from some investors, whereas the offer price is set first in New Zealand offers. Therefore underwriters have not traditionally been able to utilise presale information gathering in New Zealand under a fixed price issue mechanism. Presale information use has been utilised more recently through the introduction to the New Zealand market of constrained open priced issues, where information gathered from "roadshows" and broker feedback is used by investment bankers to set the final issue price within a constrained price range.

interaction between underwriters and knowledgeable investors helps to support this cooperation.

The Benveniste and Spindt model has several implications, only some of which are directly testable. First, "regular" investors should get preferential treatment in allocations, a conclusion with much anecdotal support. Second, when investor information is more valuable, underpricing should increase. Further, underpricing should be positively related to the level of presales and pre-market interest.

Welch evaluated the Benveniste and Spindt mechanism by examining the implications of this mechanism for underpricing in the presence of over-allotment and minimum sales clauses. In particular, if Benveniste and Spindt are correct, then one expects that: (1) over-allotments options should reduce underpricing by making it easier to preferentially treat regular investors with good news; (2) minimum sales constraints should increase underpricing; and (3) underwriters should be compensated for accepting high minimum sales requirements and low over-allotment options.

Welch empirically tested these predictions using data on 363 best efforts offerings and 660 firm commitment offerings of U.S. companies for the period 1977-1982. Proxies for offer riskiness and other environmental factors were utilised in a sophisticated regression format. Welch found that the data supported the Benveniste and Spindt theory: high minimum sales constraints and lower over-allotment options cause underwriters to force more of the offering in the presale, leading generally to the efforts outlined above.

Loughran, Ritter and Rydqvist's (1994) and Benveniste and Wilhelm's (1990) analyses have focussed on the offer mechanism. That is, the choice between a fixed price, a constrained open price, or an unconstrained open price issue. They found that average underpricing is higher the earlier in the process of going public a fixed offering price is set - a characteristic of fixed price issues. They also found that when explicit auctions are used (an unconstrained open-price issue), very little underpricing exists. While auction mechanisms are becoming increasingly common, they have generally been introduced only over the objections of underwriters, for obvious reasons.

2.2.3 Summary of Empirical Tests

The following table presents a summary of the main empirical studies over the past two decades. This will enable a comparison with my own empirical results. Due to the skewness observed in underpricing distributions it would be better to compare medians. Unfortunately this data is not available.

Table 2-1 Summary of Empirical Findings

| Author | Year | Market | Size | Period | Average Underpricing % |
|-------------------|-------------|-----------|------------|--------------|------------------------|
| Aggarwal & Rivoli | 1990 | US | 1,598 | 77-87 | 10.67 |
| Bear & Curley | 1975 | US | 140 | 69 | 9.5 |
| Beatty & Ritter | 1986 | US | 545 | 81-82 | 9.87 |
| Carter & Manaster | 1990 | US | 501 | 79-83 | 13.1-19.6 |
| Camp | 1997 | NZ | 163 | 83-89 | 32.04 |
| Chalk & Peavy | 1987 | US | 649 | 1987 | 21.67 |
| Clegg | 1997 | NZ | 148 | 82-97 | 16.44 |
| Finn & Hingham | 1988 | Aust. | 93 | 66-78 | 29.2 |
| Firth | 1997 | NZ | 143 | 79-87 | 25.87 |
| Ibbotson & Jaffe | 1975 | US | 128 | 60-70 | 16.8 |
| Ibbotson, et al | 1988 | US | 2,439 | 75-84 | 8.6-42.8 |
| Ibbotson, et al | 1994 | US | 10,626 | 60-92 | 15.30 |
| Ibbotson | 1975 | US | 120 | 60-69 | 11.4 |
| Johnson & Miller | 1988 | US | 502 | 81-83 | 11.2-14 |
| Keloharju | 1993 | Fin. | 85 | 84-92 | 9.60 |
| Koh & Walter | 1989 | US | 66 | 73-87 | 11.2-14 |
| Lee, et al | 1996 | Aust. | 266 | 76-89 | 11.9 |
| Lee, et al | 1996 | Sing. | 128 | 73-92 | 31.4 |
| Loughran & Ritter | 1995 | US | 4,753 | 70-90 | 10.0 |
| Loughran et al | 1994 | Swe. | 162 | 80-90 | 38.2 |
| Mauer & Senbet | 1992 | US | 1,002 | 77-84 | 18.9 |
| Miller & Reilly | 1987 | US | 510 | 82-83 | 9.87 |
| Ritter | 1984 | US | 1,028 | 77-82 | 16.3-48.4 |
| Ritter | 1984 | US | 5,162 | 60-82 | 18.8 |
| Ritter | 1991 | US | 1526 | 75-84 | 14.3-17.0 |
| Tinic | 1988 | US | 204 | 23-71 | 5.1-14.2 |
| Vos & Cheung | 1990 | NZ | 144 | 79-87 | 29.44 |
| Vos & Cheung | 1993 | NZ | 149 | 79-91 | 28.77 |

2.3 Conclusions from Literature

Many of the theoretical models of IPO underpricing presented above, in addition to being ingenious, offer an appealing way to become acquainted with some of the most important ideas in modern microeconomics and finance theory. Such generally useful concepts as adverse selection, moral hazard, signalling, and information sharing assume central roles in several modern theories of underpricing. The purported lesson of each of these applications is that underpricing, while appearing anomalous, is actually just an equilibrium phenomenon illustrating some surprising consequence of rational behaviour in a suitably “peculiar” environment.

Despite the considerable intellectual work expended on the “IPO problem,” it does not appear that a single, universally valid explanation for IPO pricing is at hand. While it is perhaps quite unrealistic to ask for so much from any one theory, it is apparent that much remains to be done in modelling IPO markets.

Most theorising and discussion of the IPO problem has, at least implicitly, adopted the view that underpricing is a result of rational behaviour and, further, that this mechanism is most explicable when IPOs are viewed “in isolation.” No feature of the extent of literature is more striking than the dearth of work on any truly dynamic model of IPOs. While a number of excellent empirical studies have evaluated secular patterns in IPO returns [Ritter (1984), Ritter (1991), Ibbotson (1975)], we lack any comprehensive studies that seek to relate returns across IPOs through time. In particular, there is no model that explains why the initial returns of an IPO at time t might be relevant to the performance of some other IPO at time $t + 1$. Is it, or is it not, plausible that IPO returns might be correlated in this way? To the extent this linkage is just the old notion of “market ebullience,” one might be tempted to dismiss the entire issue. Yet it seems unlikely that investors learn nothing from the performances of previous IPOs.

A related issue, addressed indirectly by papers such as Mauer and Senbet (1992), concerns the role, if any, of IPO industry characteristics in determining the levels of “mispricing.” Mauer and Senbet, Su and Fleisher (1997) and Ritter (1984) all find some

evidence of the importance of industry characteristics in determining the level of underpricing. Clearly, uncertainty over issue values is critical: Anderson, Born, and Beard (1991) find no underpricing for closed-end investment company equity IPOs, essentially sales of repackaged financial assets. Presumably industry characteristics vary in ways that effect the ability of outside investors to accurately value IPO shares. Further, market reception of one IPO in an industry may reveal information on investor sentiment relevant to the success of later IPOs in the same industry.

The above discussion suggests the following classification scheme. Seller specific information relevant to valuing an IPO might be of (at least) three types. First, information specific to the issuing firm, including its prospects and the competence of its management, is clearly valuable to investors. Information of this sort is the type most often analysed in theoretical models of IPOs, but is by definition useless for valuing other IPOs. Second, investors may obtain information relevant to the industry or sector in which the IPO occurs. In this case, reception of one IPO might provide information on the prospects of later IPOs in the same industry. Third, information may be of a general sort so that the reception of one IPO is informative about the prospects of others in various sectors. Empirical evidence that something like the above classification scheme is operative is not hard to find: Mauer and Senbet (1992) and Ritter (1984) provide examples.

It is widely believed that the distribution of oversubscribed shares gives preference to “insiders,” particularly in the U.S. McStay (1992) notes that, in the context of a Rock-type adverse selection model, biases in share distribution can improve efficiency when “insiders” correspond to “uninformed” traders. This occurs because preferential treatment of uninformed traders reduces the underpricing necessary to secure uninformed participation in the offering. While it might be unrealistic to believe the preferred (ie. profitable) customers of brokers are uninformed in this sense, consideration of this issue clearly raises the problem of how shares are actually distributed, an issue about which little is known. Since the distribution scheme may affect the levels of underpricing selected, there is a social interest in the form distribution takes.

Finally, the existence of large average discounts in most equity IPOs acts as a kind of “tax” on firms seeking to raise investment capital in the equity markets. This tax is enormous, representing almost 15% on average for a typical issue. When the discounts are viewed as taxes on issuing firms (taxes which are paid to investors instead of the government), one expects to see a variety of effects familiar from the analysis of the welfare consequences of taxation. In particular, larger discounts imply: (1) smaller issues; (2) fewer firms going public; (3) excessive reliance on debt financing; and (4) diminished inventive activity. All of these effects are probably deleterious in the long run. Further, evidence suggests that smaller issues exhibit even greater underpricing, suggesting that the “tax” is especially burdensome on small firms.

Understanding the IPO mechanism will likely remain a core problem for financial economics. The importance of venture capital and new business start-ups elevates the IPO discount phenomenon to an issue of non-trivial social concern. The value of insight into this problem is not reduced by the difficulties borne in obtaining it.

3. Initial Public Offerings In New Zealand

3.1 Characteristics of IPOs

The New Zealand IPO market has been extremely active in the past 15 years. From 1982 to July 1997 there have been 272 new listings.

This study aims to measure the average and median amount of underpricing in percentage and total terms and to measure how this varies with different characteristics of the initial offer. It also aims to construct a practical model using multivariate analysis which will enable the prediction of the level of underpricing of a new issue based on its specific characteristics.

The literature review in Chapter 2 summarises the various characteristics of IPOs that previous empirical tests have utilised to proxy the large extent of IPO underpricing hypotheses. This has assisted me in the choice of variables to examine underpricing in the New Zealand market.

The first part of this chapter describes the characteristics used to investigate underpricing of IPOs in New Zealand. The second part describes the methodology used in the univariate and multivariate analyses.

3.1.1 Risk Aversion / Ex Ante Uncertainty

The Total Dollar Amount of Shares (Size of Offer)

The size of an offering is often used as a proxy for risk. Beatty and Ritter (1986) measure risk as the inverse of the gross proceeds of an issue. Larger issues, using the same method as Beatty and Ritter, are expected to be less risky than smaller issues. The ex ante uncertainty of the value of the new listing is also expected to decrease with the size of the issue.

Whether the Company Listing is a New or Existing Company

Many established companies list on the Stock Exchange to raise new capital and are able to show previous earnings and profit forecasts from their operations. However, other companies are established as a result of raising equity from the public for a specific venture or to acquire existing companies. These new companies have no past operating history and are likely to be viewed as more risky by the market than established businesses. Many firms of this sort were listed on the New Zealand Stock Exchange during the bull market years preceding the October 1987 stock market crash.

Loughran, Ritter and Rydqvist (1993) use a similar proxy regarding a firm's age and find that older firms were underpriced less than newer firms.

The Proposed Use of Proceeds

A number of papers have examined the link between value uncertainty and underpricing including: Ederington (1974), Bear and Curley (1975), Beatty and Ritter (1986), Miller and Reilly (1987), Johnson and Miller (1988), and Carter (1992). Almost all such analyses utilise a "proxy" approach to measuring value uncertainty, one of which is the use of offer proceeds given in the prospectus.

Various uses of proceeds are listed in the prospectus of the listing company. These have been categorised into equity raising, debt repayment or a combination of equity and debt repayment.

Issuer's Industry Sector

Mauer and Senbet (1992), Ritter (1984) and Su and Fleisher (1997) investigate the effect of the issuer's industry category on the amount of underpricing. Su and Fleisher find that durable and non-durable goods industries have larger underpricing than other industries,

suggesting that the proportion of high-value firms going public is larger in durable and non-durable goods industries than in other industries.

3.1.2 Signalling and Share Retention

These variables test the signalling hypothesis of Leland and Pyle (1977) and the Downes and Heinkel (1984) share retention hypothesis.

Lee, Taylor and Walter (1996b) believe the role of escrow requirements (ie. restrictions on insider selling) for IPOs enhances the possible explanatory power of signalling models which rely on the level of insiders' retained ownership [Leland and Pyle (1977)]. While voluntary restrictions may add to the mandatory requirements, Australian listing regulations typically require a minimum holding period for the vendor of 12 months.⁷ Lee, Taylor and Walter find such restrictions add weight to the 'commitment' implied by retained ownership, thereby negating at least some of the criticism offered by Gale and Stiglitz (1989). Gale and Stiglitz argue that insider ownership might not represent a continuing commitment because secondary sales by the vendor can occur. Thus, retained ownership cannot reliably discriminate high and low quality firms at the time of the IPO.

The Proportion of Shares Offered to the Market Capitalisation of the Company

The market capitalisation is measured following the issue of new shares, where market capitalisation equals the number of shares issued multiplied by the offering price of shares. This will show the proportion of the company made available for investment by the IPO. Leland and Pyle (1977) and Carter and Manaster (1990) argue that issuers can signal the quality of an IPO by retaining a relatively large stake. Camp (1997) believes this variable is a good proxy for the firm's signal of quality and also a test of Rock's (1986) "winners' curse."

⁷ There are no such requirements in New Zealand, although a number of issues have imposed 'lock-up' periods on the vendor's stake.

Whether the Shares Offered are New Shares or Existing Shares

This study has developed this variable to show whether the company is seeking new capital or whether it is listing as a result of the sale of existing shares. The sale of new shares proxies the possible expansion of the firm, while the issue of existing shares signals a sell-down by existing shareholders, with possible connotations of a negative outlook.

Vendor's Majority Stake after Sale

If the shares offered are existing shares, this variable measures the proportion of the company held by the vendor following the sale of the shares. This study has developed this variable to proxy an "insider" signal of firm quality and future prospects

Involuntary or Voluntary Sell Down

For the sale of existing shares by the vendor, this variable measures whether the sale has been of a voluntary nature, or as a result of other forces, say regulatory control over overseas investors. This study has also developed this variable to proxy an "insider" signal of firm quality.

3.1.3 Market Condition

Hot or Cold Market

This variable examines the hypothesis of Ritter (1984) and Ibbotson, Sindelar and Ritter (1988) that new issues in a “hot issues” market are underpriced by more than those in a “cold issues” market.⁸

The bull market years of 1983, 1986 and 1987 are defined as hot periods with the remaining years in the 1982 to 1997 period being cold market years (see Appendix F). This study has classified 1997 as a cold year, which, even considering the recent volatility in the share market, appears a sound judgement.

3.1.4 Underwriter Reputation

Underwriter Reputation

Carter and Manaster (1990) suggest that underwriter reputation plays a role in reducing the degree of information asymmetry.⁹ Investment banks offer independent certification of the issuer’s risk. More reputable investment banks tend to handle less risky IPOs to protect their reputation capital, hence the degree of underpricing is expected to be inversely related to the underwriter’s reputation, where the more prestigious the investment bank, the smaller the degree of underpricing for the IPO, *ceteris paribus*.

⁸ For a definition of Hot and Cold markets refer to Appendix H.

⁹ Carter and Manaster (1990) developed a ranking scale for underwriters determined by examining the “tombstone” announcements of all the IPOs in their sample period. The rankings are determined by examining the tombstone announcements and assigning an integer rank, zero to nine, for the position in the tombstone. These tombstones are not widely published in New Zealand so this method cannot currently be utilised. However, the ranking method this study adopts is principally the same.

The Reputation of the Underwriter(s) of the IPO

The reputation of any underwriter has been defined in previous studies [Beatty and Ritter (1986), Vos and Cheung (1993)] as the sum of all issues underwritten by the lead underwriter. For any issue where there is more than one lead underwriter the total amount underwritten is divided equally between the lead underwriters.

This variable measures whether more prestigious underwriters price more fully than less prestigious underwriters.

Market Shares of Underwriters

Underwriters who underprice by more or less than what their reputation are likely to lose market share in the following period.

By splitting the sample period into sub periods this study is able to measure whether the rank of underwriters change through time.

Amount of Brokerage paid to Underwriter and Broker

This is an additional proxy for underwriter reputation, with, presumably, more prestigious underwriters commanding a greater percentage of underwriting fees. In addition the underwriting fees are also a proxy for the risk of the offer. More risky offerings will command a higher payment to the underwriter to consider jeopardising their reputation.

3.1.5 Contract Choice / Offer Mechanism

According to Lee, Taylor and Walter (1996a, 1996b) and Loughran, Ritter and Rydqvist (1994) this is currently the main area of research into IPO underpricing. They suggest differences in the contractual mechanisms and the length of time in advance of the actual issue that the issuer is committed to an initial offer price are positively related to underpricing. Auctions of shares are found to effectively eliminate underpricing.

Welch's (1991) analysis of contract choice focused on the difference between best efforts offerings and a firm commitment offering. This study will instead adopt an approach similar to Lee, Taylor and Walter (1996a, 1996b) and focus on the contract choice of an open-priced offering compared with that of a fixed-price offering and also the effect of the time it takes from the registration of the prospectus to listing. Thus, this study uses two variables to proxy the relationship between the offer mechanism and the level of underpricing.

Time until Listing

Chowdhry and Sherman (1994), Su and Fleisher (1997) and Lee, Taylor and Walter (1996b) investigate the relationship between the amount of underpricing and the number of days elapsed between the registration of a prospectus and the first day of market trading. Chowdhry and Sherman find a positive relationship, while Su and Fleisher find no relationship.

This variable is a good proxy for the offer mechanism. New Zealand prospectuses are registered with the statutory authorities for an average of seven to eight weeks (see Appendix E) prior to the commencement of trading on the New Zealand Stock Exchange. This (readily) observable period reflects three distinct components. First, there is a period between the official registration of the prospectus and the opening of the issue to subscribers. Second, there is a period between the opening of the issue and closing, at which full (or minimum stipulated in the prospectus) subscription is reached. Finally, there is some delay between the issue closing and the commencement of

exchange trading, during which the allocation of shares occurs. Given that the first and third components are largely standardised, I expect that variations in the total time that elapses between prospectus registration and the commencement of exchange trading will primarily reflect the time it takes for the issue to sell. This period proxies for fluctuations in the level of demand, principally among ‘informed’ investors. This view is reinforced by the allocation process used for New Zealand IPOs, which can conceal biases in the rationing of underpriced issues. Hence, it is unlikely that issues experiencing long delays have had difficulty attracting interest from ‘informed’ investors, reflecting Rock’s (1986) “winners’ curse” faced by the uninformed.

The elapsed time between prospectus registration and eventual listing may capture the extent to which uninformed investors face a winners’ curse, via the presence or absence of informed investor demand. I expect a negative relationship between underpricing and the listing delay.

A description of the New Zealand issuance procedures is provided in Appendix J.

Open-Priced or Fixed-Price Offering

Open-priced offerings are a relatively recent phenomenon in the New Zealand IPO market,¹⁰ with only six constrained open-priced IPOs since this type of offering was introduced with the Telecom Corporation offer in June 1991. Although the sample may be small at this time, it is worth investigating the “presale solicitations of interest” hypothesis investigated by Benveniste and Spindt (1989). Benveniste and Spindt indicate that prior to a new issue, investment banks perform a “roadshow” and make presentations to potential investors, brokers, and others. Indications of interest (or lack of interest) expressed by these investors may be valuable market signals useful in pricing an open-priced issue. This information is unable to be incorporated into the pricing of a

¹⁰ A good description of open-priced offerings is provided in Benveniste and Wilhelm (1997)

fixed-price issue because the price is all ready set before the roadshow. To a certain extent, open-priced issues can adjust the final offer price to reflect the changes in the market between registration and listing by moving the issue price up or down the open-price range accordingly. Therefore, we would expect open-priced issues to be underpriced less than fixed-priced issues.

3.2 Methodology

Underpricing is calculated as the abnormal return of the IPO from the date of offer to the listing date. It is necessary to establish a control to isolate effects of the new company's potential share price performance from other exogenous effects. Thus underpricing is measured by the abnormal return, measured as the return on the individual share less the return on the market from the offer date to the list date. Measuring the underpricing in this way adjusts the underlying effect of movements in the market between the offer and the list date.¹¹ In hot markets the market is moving quite rapidly and I seek to measure the movement in the price of the IPO that cannot be explained by movement in the market. This return is not risk adjusted, as no risk variable (ie beta) is available prior to listing.

The abnormal return for each IPO is defined in the same way as Rock (1986) as the value X_{it} where

$$X_{it} = \left[\frac{(P_t - P_0)}{P_0} - \frac{(M_t - M_0)}{M_0} \right] \times 100 \quad (3)$$

where:

P_t = the closing price of the share t trading days after the initial offering;

P_0 = the initial offering price of the share;

¹¹ An approach analogous to the zero-one version of the familiar market model.

M_0 = the value of the NZSE40 index on the date of the offering; and

M_t = the value of the NZSE40 index t days after the offering.

Average underpricing is measured as the average of all IPO abnormal returns.

$$X_{it} = \frac{1}{n} \sum_{i=1}^n X_{it} \quad (4)$$

Since the returns of this sample of IPOs are only market-adjusted, but not risk-adjusted, the average excess return from list date to 7 days, 14 days, 30 days, and 60 days hence are also calculated to examine if the underpricing result is simply due to the riskiness of this portfolio of firms. A one-sample Wilcoxon test is computed to test the null hypothesis that the X_{it} 's have zero medians.

The New Zealand Stock Exchange annual reports and the Buttle Wilson Investment year book are used to identify IPOs. Prospectus information and newspaper clippings are used to collect information about the offering price and specific variables relating to each firm.

Share price information has been extracted from the Fay, Richwhite Equities database and Datastream.¹²

Market return was measured from the daily NZSE 40 Capital index (formerly the Barclays index).

In addition; the sample is partitioned into the 1982-87 and 1987-97 sub-periods to test the effect on the market of the 1987 share market crash. A Mann-Whitney test is used to determine if the medians of the two samples are significantly different.

¹² ©Datastream International

3.3 Univariate Analysis

The univariate analysis of the various characteristics of underpricing is twofold. Due to some very pronounced outliers and a skewed distribution, this study will calculate medians as a measure of the centre and analyse nonparametric statistics. The majority of previous IPO studies have made incorrect assumptions regarding the normality of the underpricing distribution and measured means and performed *t*-tests to measure the significance of their results. Although the approach is statistically incorrect, I will also adopt this methodology, both as a cross-check of my analysis of medians and nonparametric tests, and also to test the assumption of a normal distribution made by these other studies.

This problem is eliminated in the multiple regression model where the underpricing distribution is normalised through a logarithmic transformation of the dependent variable.

3.3.1 Statistical Significance using Nonparametric Tests

As Section 4.1 indicates, the assumption of a normal distribution of underpricing is false. Therefore this study will present statistics and tests that make no assumptions regarding the distribution of data. This section describes the nonparametric tests performed. These nonparametric tests use ranks to measure significance, which is an important characteristics in a sample such as this where large observations, such as Telecom Corporation, may skew the results.

One-Sample Wilcoxon Test Median

To determine whether the median (η) underpricing calculated for the various underpricing factors is statistically different from zero, the following hypothesis test is applied using the one-sample Wilcoxon test:

$$H_0: \eta=0$$

$$H_a: \eta>0$$

The one-sample Wilcoxon test assumes that the data is a random sample from a symmetric population. The test first eliminates any observations equal to the hypothesized median. Then the pairwise (Walsh) averages, $(X_i + X_j)/2$ for $i \leq j$, are formed. The Wilcoxon statistic is the number of Walsh averages exceeding the hypothesized median, plus half the number of Walsh averages equal to the hypothesized median. This statistic is approximately normal. Under H_0 , it has mean $N(N+1)/4$, where N is the number of observations for the test. The attained significance level (p-value) is calculated using a normal approximation with a continuity correction.

Mann-Whitney Test

The Mann-Whitney Test, or two-sample Wilcoxon rank sum test, is a two sample test for the difference between two population medians.

Let η_i be the median of the first population and η_j be the median of the second population. Then Mann-Whitney tests:

$$H_0: \eta_i - \eta_j = 0$$

$$H_1: \eta_i - \eta_j \neq 0$$

Mann-Whitney assumes the data are independent random samples from two populations that have the same shape (hence the same variance) and a scale that is at least ordinal. The test first ranks the two samples together, with the smallest observation given rank 1, the second smallest, rank 2 etc. If two or more observations are tied, the sum of the ranks of the first sample is calculated. This sum is the test statistic W . A small value of W indicates that η_i is smaller than η_j , a larger value indicates that η_j is smaller than η_i .

Spearman's Rank Correlation Coefficient

Correlation coefficients are also distorted by the skewness in underpricing. Spearman's correlation is a nonparametric correlation coefficient which makes no assumptions regarding the distribution of the data.

Unlike the Pearson correlation, the Spearman rank correlation coefficient does not require the relationship between variables to be linear by applying a ranking system.

The correlation coefficient is:

$$r = \frac{\sum_{i=1}^n \left(R_i - \frac{n+1}{2} \right) \left(S_i - \frac{n+1}{2} \right)}{n(n^2 - 1) / 12} \quad (8)$$

where: R_i = ranks of underpricing for IPO characteristic X_i

R_j = ranks of underpricing for IPO characteristic X_j

n = number of observations

1. $-1 \leq r \leq 1$
2. r near +1 indicates a tendency for the larger values of X_i to be associated with the larger values of X_j . Values near -1 indicate the opposite relationship
3. The association need not be linear; only an increasing/decreasing relationship is required.

Kruskal-Wallis Test

The Kruskal-Wallis test is a generalisation of the procedure used by Mann-Whitney, and offers a nonparametric alternative to the usual one-way analysis of variance. The test assumes that the data arise as k independent random samples from continuous distributions, all having the same shape. The null hypothesis of no differences among the k populations is tested against the alternative of at least one difference.

First the samples are ranked. If two or more observations are tied, the average rank is assigned to each. The test statistic is

$$H = \frac{12 \sum n_i (\bar{R}_i - \bar{R})^2}{N(N+1)} \quad (9)$$

where: n_i = number of observations in group i

N = total sample size

\bar{R}_i = the average of the ranks in group i

\bar{R} = is the average of all ranks

Large values of H suggest that there are some differences in location among the k populations.

3.3.2 Statistical Significance Assuming a Normal Distribution

To determine whether the underpricing calculated for the various underpricing factors is statistically different from zero, the following hypothesis test is applied:

$$H_0: \mu=0$$

$$H_a: \mu \neq 0$$

To determine whether the mean abnormal return is significantly greater than zero, or positive, the following hypothesis test is applied:

$$H_0: \mu=0$$

$$H_a: \mu > 0$$

The test statistic for both tests is:

$$t = \frac{x - \mu}{\sqrt{s^2 / n}} \quad (5)$$

where: s = standard deviation of underpricing;

μ = mean underpricing;

n = number of observations.

The null hypothesis is rejected if the test statistic exceeds the critical values shown in Table 3-1 for verifying levels of significance.

Table 3-1 Critical Values for Hypothesis Testing for Large Samples

| Significance Level | Two Tailed Test | One Tailed Test | Level of Significance |
|--------------------|-----------------|-----------------|-----------------------|
| 10% | 1.65 | 1.28 | * |
| 5% | 1.96 | 1.65 | ** |
| 1% | 2.58 | 2.33 | *** |

A two tailed test is used when the alternative hypothesis tests whether the mean is significantly different from zero, in either direction. A one tailed test is used to test whether the mean is significantly greater than zero. This study presents only the two-tailed test statistic in the results chapter and indicates the level of significance.

To test whether the mean underpricing observed for one IPO characteristic is significantly different than the mean for another characteristic, the following hypothesis test is used:

$$H_0: \mu_i - \mu_j = 0$$

$$H_1: \mu_i - \mu_j \neq 0$$

The test statistic assuming equal variance is

$$t = \frac{(\bar{X}_i - \bar{X}_j)}{\frac{S_p}{\sqrt{\frac{1}{n_i} + \frac{1}{n_j}}}} \quad (6)$$

The test statistic for unequal variances is

$$t = \frac{\bar{X}_i - \bar{X}_j}{\sqrt{\frac{s_i^2}{n_i} + \frac{s_j^2}{n_j}}} \quad (7)$$

where

\bar{X}_i = mean underpricing for IPO characteristic i

\bar{X}_j = mean underpricing characteristics for IPO characteristic j

$$S_p^2 = \frac{(n_i - 1)s_i^2 + (n_j - 1)s_j^2}{n_i + n_j - 2}$$

(pooled standard deviation for the differences between the means).

This statistical test defines the characteristics of an IPO to be no different, or they do not influence the size of the underpricing, if the null hypothesis is accepted.

The critical values for this two tailed test are the same as in Table 3-1.

3.4 Multivariate Analysis

This study uses a stepwise estimation multiple regression technique to develop an explanatory model for the underpricing of IPOs in New Zealand. The aim is to develop an empirical model that will not only explain historical underpricing, but more importantly, be used as a practical prediction tool for future IPO underpricing.

Stepwise Multiple Regression

Stepwise estimation is a popular sequential approach to variable selection. This method starts with selecting the best predictor of the dependent variable with additional variables selected in terms of the incremental explanatory power they can add to the regression model, measured by the adjusted coefficient of determination (adjusted R^2). Independent variables are added as long as their partial correlation coefficients (t -values) are statistically significant. Independent variables may also be dropped if their predictive power drops to a non-significant level. The primary distinction of this approach to an ordinary least squares forward or backward elimination method is the ability to add or delete variables at each stage.

Multivariate Diagnostics Tests

This study uses a number of diagnostic tests to test the validity of the multivariate model through the analysis of residuals. Multiple regression analyses can be severely and adversely affected by failures of the data to adhere to the assumptions that customarily accompany regression models. Diagnostics methods are available to help identify many specific kinds of failure and are thus valuable adjuncts to regression analyses.

This study uses the following methods outlined in Vellman and Welsch (1981) and Larsen and McCleary (1972):

Table 3-2 Multivariate Diagnostic Tests

| Test | Reason for Test |
|------------------------------------|--|
| Durban-Watson | Randomness of sample |
| Colinearity / Multicollinearity | Cross-correlation of independent variables |
| Partial Residual Plots | To detect outliers, assess the presence or absence of inhomogeneity of variance and determine if a transformation (eg. logarithm) is needed or if another term should be added |
| Standardised Residuals | Normality |
| Mahalanobis Distance | Outlier influence |
| Cook's Number | Outlier influence |
| Leverage | Outlier influence |

3.5 The Sample

Of the 272 IPOs in New Zealand from 1982 to July 1997, 148 have been included in the final sample.

The IPOs excluded in this study were extracted for the following reasons:

1. 18 companies are excluded, as their listing was a result of a takeover, merger, share giveaway, compliance/courtesy listing, or private placement of shares. These offerings did not include an offer of shares to the general public.
2. 42 companies are excluded as investigation failed to find any information at all about these offerings.
3. 9 companies are excluded because there was no price data available from the databases used.

4. 3 companies are excluded because no offer price could be located for their issue.
5. A further 38 companies are excluded because there was no prospectus date from which to measure the market movement between the prospectus date and the list date. A proxy measure is used to estimate the prospectus date for these observations in an attempt to increase the sample size. The results from this analysis are reported in Appendix E.
6. 14 IPOs excluded from the final sample reported that options were issued in conjunction with the ordinary shares. These options were offered freely usually on the basis of 1 option for every 2 or 3 shares subscribed for. For the investor in an IPO, the return on the company is the value of the ordinary shares plus the value of the free options. Option prices could not be extracted from the databases used for 14 offering companies. These companies are excluded from the final sample because including them would have a deflationary effect on the size of the underpricing measured. A discussion on excluding these companies is reported in Appendix G.

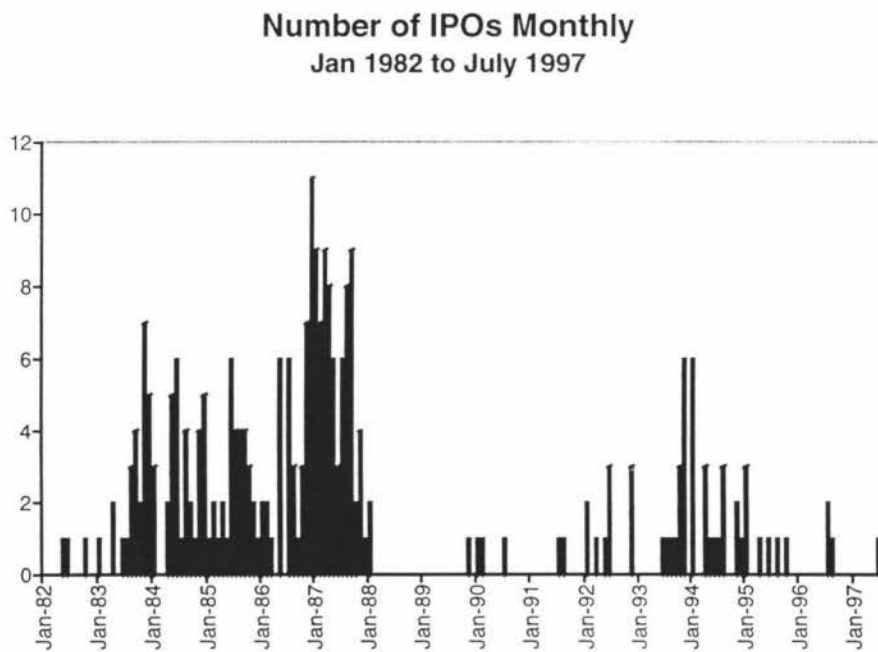
Data for the characteristics of IPOs is incomplete for some of the 148 companies that form the final sample. The type of information missing does not seem to be common across any particular characteristic.

4. Empirical Results

4.1 IPOs in New Zealand

IPOs in New Zealand have occurred rather sporadically throughout 1982 to July 1997. Graph One shows a monthly count of IPOs over the sample period.

Figure 4-1 Number of IPOs.



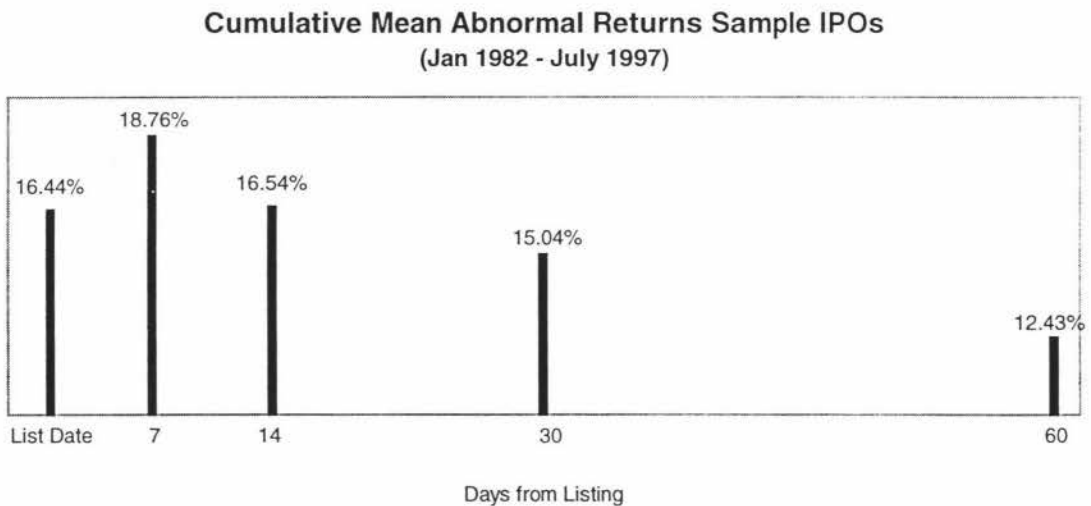
Bursts of IPO activity are obvious. A large proportion of all IPOs occurred in the three years 1983, 1986 and 1987. These periods have been defined as “hot” markets for further analysis below. The “dead” market is another interesting observation, where only 16 new companies listed between the October 1987 stock market crash and December 1992.

Average underpricing for all IPOs included in the final sample is measured at 16.44% (median 10.05%) from the offer date to the list date. If there is no adjustment for the market movement over the time from offer to list the underpricing is measured at 18.93% (median 8.20%). Both these results are statistically significant to the 5% level. The results are also comparable to other studies (see Section 2.2.3).

Table 4-1 Underpricing of IPOs in New Zealand 1982-97

| Sample Period | Jan 1982 – July 1997 |
|------------------------|----------------------|
| Number of Observations | 148 |
| Average Underpricing | 16.44% |
| Median Underpricing | 10.05% |
| <i>t</i> -statistic | 5.47*** |
| Wilcoxon test | 8631 |

Figure 4-2 Cumulative abnormal returns.



Cumulative abnormal returns from the day the prospectus is issued until 60 days following the listing date of the IPO show a 12.43% return on average. Thus IPOs on average retain most of the underpricing that occurs on the initial listing date, implying that underpricing is not a one-day wonder.

The sample is also partitioned into 1982-87 and 1988-97 sub-periods to test the effect of the 1987 share market crash.

Table 4-2 Effect of the 1987 Share Market Crash

| Period | Number | Average Underpricing | t-statistics | Median | Wilcoxon |
|------------|--------|----------------------|--------------|--------|----------|
| Pre-Crash | 102 | 19.68% | 4.63*** | 11.54% | 3991 |
| Post-Crash | 46 | 9.26% | 5.00** | 8.24% | 921 |

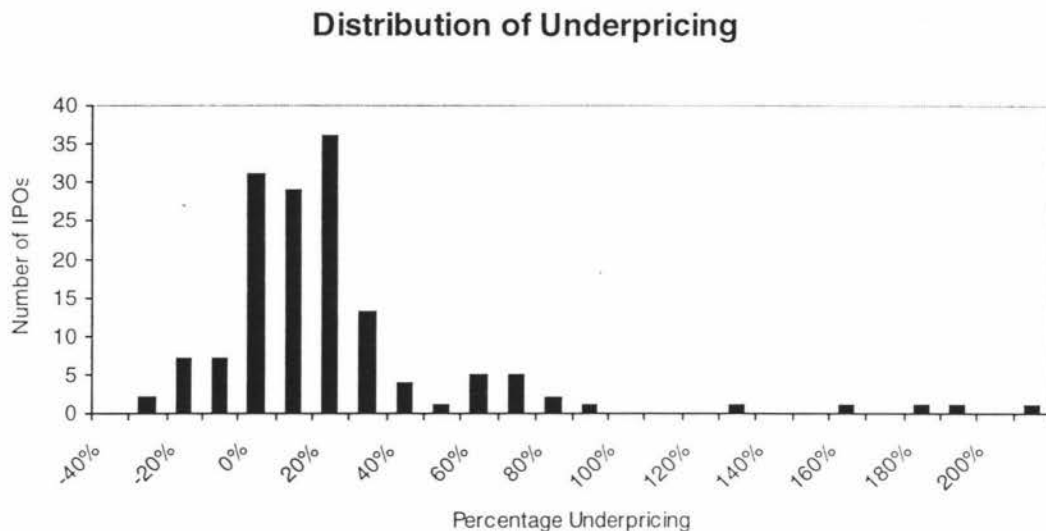
Mann Whitney 7719

This result illustrates that the 1987 share market crash has had a significant effect on the New Zealand IPO market. The pre-crash period is characterised by IPOs of small, risky companies which are underpriced more to compensate for ex ante uncertainty [Beatty and Ritter (1986)]. Underpricing has reduced significantly as these smaller, more speculative issues have disappeared from the New Zealand IPO market post-crash.

The variation in the returns found over the sample period is rather large. Rock (1986) suggests that uninformed investors face a “winners’ curse” in IPOs because informed investors will withdraw from the process if an issue is overpriced. Notice that while the mean return is 16.44%, the minimum is -35.40% (overpriced by 35.40%) and the maximum is 207.72% (underpriced by 207.72%). Thirty-three of the 148 issues are overpriced.

The probability distribution of this sample shows large tails, consequently this sample has a large variance which may make it hard to generalise how the offer price of an IPO is set. This distribution is skewed to the right and exhibits above average kurtosis. These characteristics are similar to those reported in other studies [Ibbotson (1975)]. The distribution is too skewed to assume normality and the use of the mean as a measure of the centre. The majority of previous studies have not recognised the statistical implications of skewness. Nonetheless, the average underpricing for this sample is found to be statistically significant at the 5% level.

Figure 4-3 Distribution of IPOs



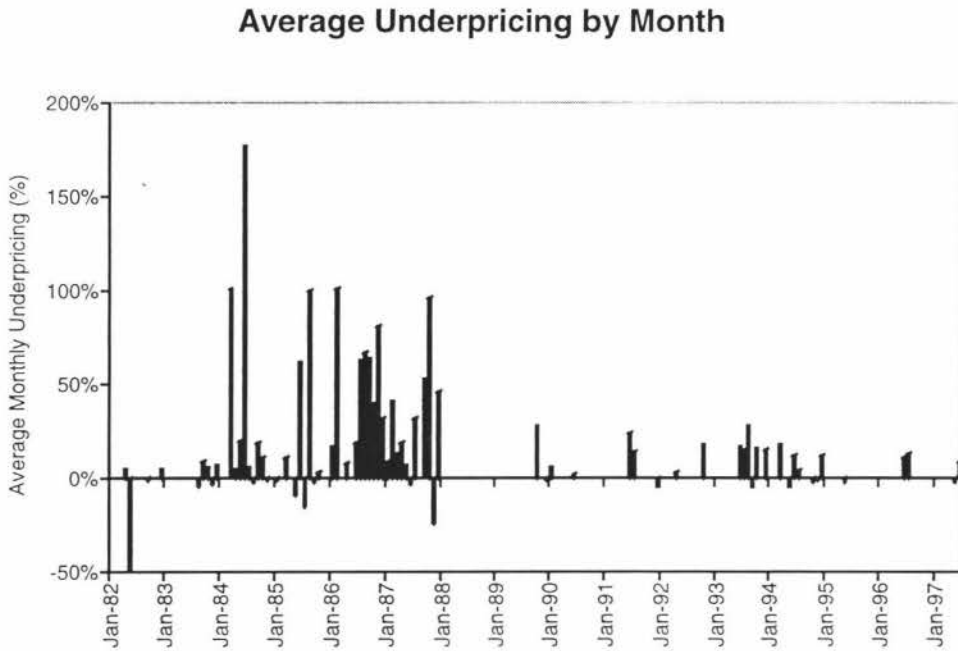
By excluding the most extreme 5% of the sample (the seven largest under or over priced offerings) the average underpricing falls to 10.10% (median 8.08%) and the standard deviation reduces to 0.209, half the previous variance. The average underpricing is still significant to the 5% level, thus outliers can not explain the significance of the results.

This also implies that the seven largest underpriced issues have a substantial effect on the measurement of the average and median underpricing.

The regression analysis assumes a normally distributed dependent variable with constant variance for all values of the independent variables. The natural logarithm of underpricing removes skewness and is used as the dependent variable in the multivariate model. However, by taking the natural logarithm of underpricing. The multivariate model is effectively limited to the analysis of underpricing because overpriced issues have been characterised as negative returns.

The measurement period from January 1982 to July 1997 can be divided into monthly subperiods and the average underpricing in any particular month is shown in Graph Four Figure 4-4 below.

Figure 4-4 Underpricing by Month.

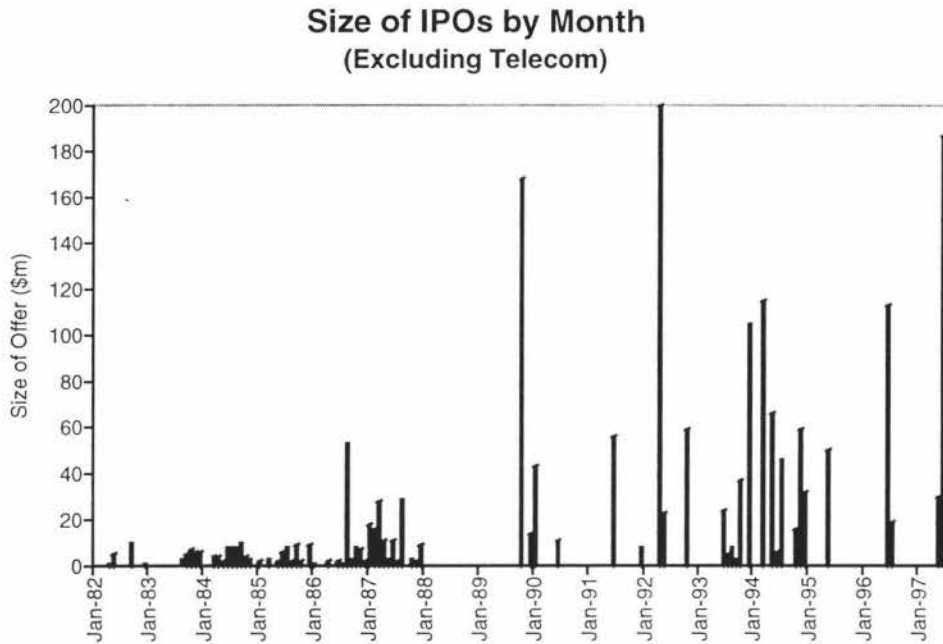


Average underpricing shows cyclical patterns when reported monthly throughout the sample. Issues in hot markets (1983, 1986 and 1987) tend to be underpriced by more than issues in cold markets. This phenomenon is explored in Appendix H.

The average amount of underpricing, measured as the difference between the offer price and the listing price multiplied by the number of shares offered for sale, was \$4,549,645 for all issues. There were 100 issues in the sample that listed at a discount or were underpriced by an average of \$7,582,902 and 33 issues that were over priced, by an average of \$1,473,696.

Fifteen issues listed at their offer price. These firms are likely to be thinly traded with no transactions in the first days of trading. However, this cannot be determined because there is no trading volume data available. Hence I have included these firms in the sample. The exclusion of these firms would raise the average level of underpricing by 1.26% (median by 1.98%), and make the results more significant.

Figure 4-5 Size of IPO by month.



Monthly underpricing averages are shown in Figure 4-5. Issues such as Telecom and to a lesser degree Progressive Enterprises, Bank of New Zealand and Air New Zealand, have a substantial effect on the average amount underwritten in any particular month.

The largest public offering in the period studied was from Telecom Corporation who offered 724,285,715 shares at a discount of \$0.35 per share. This IPO has had a substantial influence on the measurement of average underpricing. When Telecom is excluded from these calculations the average amount of underpricing falls to \$3,002,904 and the 100 issues that were underpriced were so by \$5,194,630. This is more compatible with the results presented from Vos and Cheung (1993) who report 106 underpriced issues by an average of \$4,902,482 and 149 issues representing total underpricing of \$3,113,893 on average.

4.1.1 Comparison with Previous Results

The underpricing level measured in Vos and Cheung (1991,1993), Firth (1997) and Camp (1997) are larger than from this study. Both Vos and Cheung and Firth's sample periods start in 1979, while this study starts in 1982. The sample periods of both these studies overlap but are not concurrent. This studies' sample period does overlap with Camp's, whose sample period is between 1983 and 1989.

Table 4-3 Summary of Empirical Studies of IPO Underpricing in New Zealand

| | Vos & Cheung | Vos & Cheung | Firth | Camp | Clegg |
|------------------------|-----------------|-----------------|--------|--------|--------|
| Year of Study | 1990 | 1993 | 1997 | 1997 | 1997 |
| Sample Size | 144 | 149 | 148 | 163 | 162 |
| Period | 79-87 | 82-91 | 79-87 | 83-89 | 82-97 |
| Mean Abnormal Return | 29.44% | 28.77% | 25.87% | 32.04% | 16.44% |
| Median Abnormal Return | - | - | 21.93% | 15.98% | 10.05% |

Table 4-3 indicates that the underpricing level measured in this study is lower than previous New Zealand studies, but consistent with other international studies presented in Section 2.2.3. As Table A-1 in Appendix E indicates, this study obtained a level of underpricing similar to the other New Zealand empirical studies by adding more observations to the sample, principally from the "hot" market periods at the beginning of the sample period. As Section 4.2.3 and Appendix H indicates, issues in hot periods are underpriced by more than in cold market periods, which largely explains the difference between results.

This study is unsure as to whether Vos and Cheung included or excluded 1991 from their study, as they seem to have left out the Telecom IPO, and the total amount underpriced for several underwriters, reported in their appendix, does not concur with the results presented in this study. This study does not have the ability to verify the sample selection process of Camp or Firth.

Of the other New Zealand results, Camp's are the most comparable due to the overlapping sample periods. Camp include all 163 issues in his sample period in his final sample. This means he has more observations over his seven year sample period than this study has over a sixteen year period. This compounds the influence of the "hot issues" period mentioned above. This study measures average underpricing at 20.07% (median 9.93%) over Camp's sample period, with the sub-sample including only 101 observations. This compares to Camp's study which measures average underpricing of 32.04% (median 15.98%).

The effect of the "hot issues" market is also demonstrated in the results presented in Vos and Cheung's 1990 and 1993 studies. By adding five additional observations to their sample from the cold markets of 1988 to 1991, average underpricing of their extended sample decreases.

Another interesting comparison is the results of Vos and Cheung (1990) with Firth. These studies have overlapping time periods, but Firth has four additional observations. The effect of these additional observations, which are presumably overpriced, is to decrease average underpricing by 3.57%.

This study excluded 14 issues from the final sample, where information could not be obtained about the options issued as part of the issue, due to the possible discounting of the "real" underpricing statistic. Vos and Cheung, Firth and Camp make no mention of option prices.

4.2 Results of Univariate Analysis

This section tests a number of hypotheses. A summary null hypothesis is:

Null Hypothesis: *Underpricing of IPOs is independent of any issue-related factors.*

4.2.1 Risk Aversion / Ex Ante Uncertainty

Underpricing by Total Shares Offered

Beatty and Ritter (1986) proxy riskiness of an issue by the inverse of the gross proceeds of the issue. For larger offerings (ie. smaller inverse of gross proceeds), Beatty and Ritter predict a smaller amount of underpricing (in percentage terms).

The total dollar amount of shares calculated at the offer price has been broken into six categories to determine whether the size of the issue has any correlation with the average amount of underpricing found.

Table 4-4 Underpricing by the size of the offer

| Size | Number | Underpricing | t-statistic | Median | Wilcoxon |
|----------------------|--------|--------------|-------------|--------|----------|
| \$0 - \$5 million | 56 | 21.03% | 3.34*** | 10.09% | 1209 |
| \$5 - \$10 million | 60 | 21.29% | 3.20** | 13.56% | 413 |
| \$10 - \$20 million | 22 | 5.43% | 1.13 | 4.62% | 161 |
| \$20 - \$50 million | 14 | 6.02% | 0.96 | 4.44% | 68 |
| \$50 - \$100 million | 8 | 15.46% | 1.88* | 10.97% | 31 |
| > \$100 million | 17 | 16.40% | 3.03*** | 15.26% | 134 |

Spearman Correlation Coefficient -0.04 *Kruskal Wallis 2513*

Table 4-4 indicates that smaller issues are underpriced on average by more than larger issues. This is consistent with the assumption of size as a proxy for risk [Beatty and Ritter (1986)]. The ex ante uncertainty of the value of a new issue appears to decrease with the size of the issue. However, an analysis of medians indicates that this trend is noisy, and a strong conclusion cannot be made. The small negative correlation coefficient confirms the low-predictability of offer size observed in Table 4-4.

To check that the category classifications above did not distort any relation between size of an issue and the percent of underpricing, the Spearman correlation coefficient between the inverse of size and underpricing was measured at -0.03. This confirms a very weak relationship between the size of underpricing and the size of the offering. The Spearman correlation coefficient between the size of underpricing and the natural logarithm of the size of the offering is also -0.03.

Figure 4-6 Underpricing by Size of the IPO.

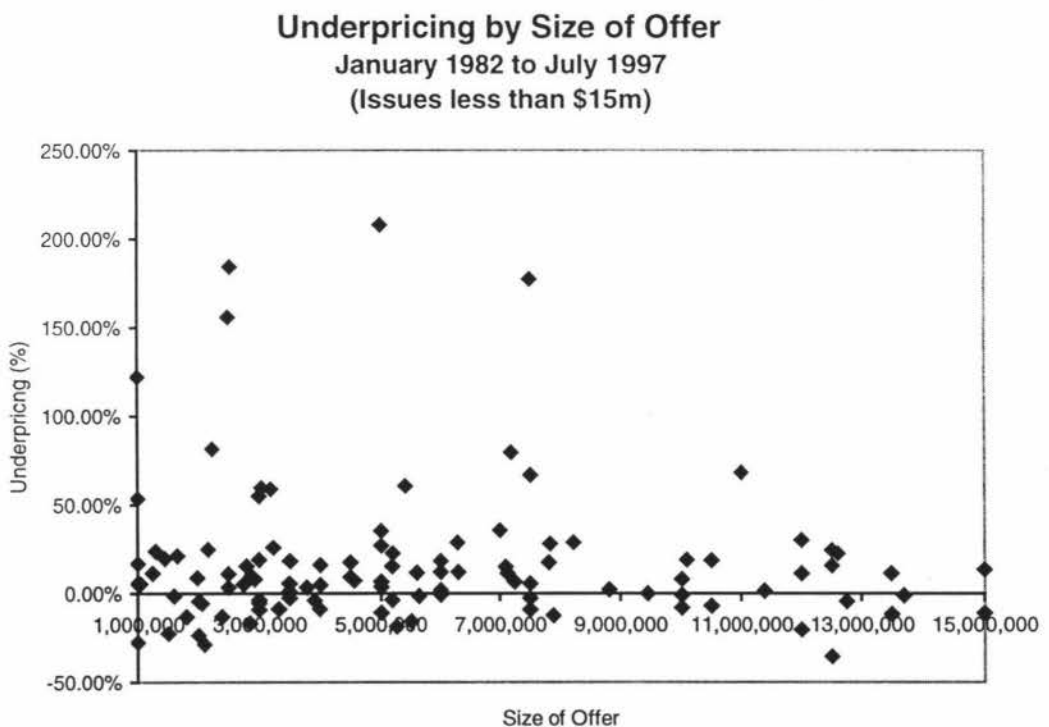


Figure 4-6 shows the distribution of the offering size against the underpricing of IPOs in this sample. This diagram illustrates that there exists no obvious pattern between the size of an offer and the percentage of underpricing.

New and Existing Companies

Existing companies are able to show previous earnings and profit forecasts from their operations, thus reducing information asymmetries. New companies provide no information about previous performance and will be harder to value by both the market and the underwriter.

Table 4-5 Underpricing of New and Existing Companies

| Type of Company | Number | Average Underpricing | t-statistic | Median | Wilcoxon |
|--|--------|----------------------|-------------|--------|--------------------------|
| New | 60 | 20.32% | 3.30*** | 11.57% | 1307 |
| Existing | 79 | 12.26% | 4.36*** | 9.52% | 2656 |
| <i>Spearman Correlation Coefficient 0.11</i> | | | | | <i>Mann Whitney 4089</i> |

As expected, Table 4-5 indicates that the amount of underpricing is higher for new companies than those who are more established. Underwriters have on average underpriced new companies by more than existing companies because of the uncertainty surrounding the potential value of the new company and to induce investors to participate in the new share offer.

Proposed use of Proceeds

IPOs occur to raise capital for the purposes of the repayment of debt and/or equity financing. The market is likely to value these capital raisings differently.

Table 4-6 Underpricing by use of funds

| Use of funds Number | Number | Average Underpricing | t-statistic | Median | Wilcoxon |
|--|--------|-------------------------|-------------|----------------------------|----------|
| Equity | 112 | 17.74% | 4.62*** | 10.52% | 4829 |
| Debt | 5 | 10.76% | 2.58*** | 9.17% | 14 |
| Debt and Equity | 4 | -2.46% | -0.51 | 0.30% | 5 |
| <i>Spearman Correlation Coefficient 0.05</i> | | | | <i>Kruskal Wallis 4526</i> | |

Although these results should be interpreted with caution, because of the small sample size and correlation, the use of offer proceeds appears to have an effect on the level of underpricing.

Table 4-6 indicates that the market values issues involving the repayment of existing debt more fully than issues where the company is raising new capital. This result indicates, in terms of information asymmetry, that the market understands the rearrangement of a company's finances more than raising new capital for expansion. This is consistent with the above result for the listing of new or existing firms. That is, underwriters have on average underpriced companies raising new capital by more than the repayment of existing debt because of the uncertainty surrounding the potential value of the use of the new capital and to induce investors to participate in the new share offer.

These results are consistent with Beatty and Ritter (1986) who find a significant relationship between the ex ante uncertainty of an IPO's value and its expected initial return. Using these proxies for ex ante uncertainty, this study provides evidence to support this hypothesis. An implication of this finding is that, if the level of ex ante uncertainty is endogenous, an issuing firm has an incentive to reduce this uncertainty by voluntarily disclosing information.

Industry Sector of Issuer

Table 4-7 indicates that there exists no obvious relationship between the level of underpricing and the industry the company operates in.

Table 4-7 Underpricing by Industry of Issuer

| Industry | Number | Average Underpricing | t-statistic | Median Underpricing | Wilcoxon |
|------------------|--------|----------------------|-------------|---------------------|----------|
| Agriculture | 23 | 16.62% | 2.86*** | 10.76% | 215 |
| Energy | 2 | 16.43% | 3.36*** | 16.43% | 3 |
| Engineering | 9 | 2.70% | 0.27 | 3.69% | 23 |
| Finance | 4 | 12.50% | 3.72*** | 12.50% | 10 |
| Food | 7 | 26.99% | 1.64 | 14.56% | 26 |
| Forestry | 5 | 14.52% | 1.39 | 15.54% | 12 |
| Information Sys. | 10 | 10.73% | 1.26 | 1.96% | 2 |
| Manufacturing | 2 | -1.61% | -0.41 | -1.61% | 1 |
| Investment | 21 | 27.68% | 2.22** | 13.62% | 174 |
| Media & Comms. | 3 | 2.98% | 0.52 | 1.86% | 1 |
| Medical | 2 | 14.33% | 1.00 | 14.33% | 3 |
| Mining | 11 | 19.41% | 1.40 | 11.12% | 33 |
| Property | 21 | 24.38% | 2.27** | 7.84% | 57 |
| Retail | 5 | 8.92% | 1.58 | 12.90% | 180 |
| Textiles | 2 | 17.40% | - | 17.40% | 12 |
| Transport | 11 | 13.88% | 2.18 | 9.32% | 3 |
| Tourism | 10 | 1.06% | 0.26 | 13.72% | 56 |

Spearman Correlation Coefficient -0.08 *Kruskal Wallis 876*

Further analysis contradicts Su and Fleisher's (1997) hypothesis that durable and non-durable goods industries are underpriced more than other industries. Table 4-8 indicates that durable and non-durable goods industries tend to be underpriced by *less* than other industries.

Table 4-8 Underpricing by Industry Sector of Issuer

| Industry | Number | Average Underpricing | t-statistic | Median Underpricing | Wilcoxon |
|---|--------|----------------------|-------------|--------------------------|----------|
| Durable & Non-Durable | 50 | 15.17% | 3.64*** | 8.92% | 1031 |
| Other Industries | 98 | 17.09% | 4.25*** | 10.50% | 3724 |
| <i>Spearman Correlation Coefficient -0.11</i> | | | | <i>Mann Whitney 3660</i> | |

4.2.2 Signalling and Share Retention

Proportion of Company Offered for Sale

The proportion of the company issued by means of the IPO is measured as the issue size (as above) divided by the market capitalisation after the issue. Market capitalisation is measured as the total number of shares following the issue multiplied by the offer price of the issue. The offer price is used to be consistent with the size of the issue above.

Table 4-9 Underpricing by Proportion of Company Offered for Sale

| Proportion | Number | Average Underpricing | t-statistic | Median Underpricing | Wilcoxon |
|---|--------|----------------------|-------------|----------------------------|----------|
| 0-25% | 32 | 18.52% | 3.33*** | 11.96% | 445 |
| 25%-50% | 48 | 15.27% | 3.37*** | 10.73% | 967 |
| 50%-75% | 22 | 35.69% | 2.70*** | 14.63% | 236 |
| 75%-100% | 38 | 5.69% | 1.54 | 3.63% | 451 |
| <i>Spearman Correlation Coefficient -0.12</i> | | | | <i>Kruskal Wallis 2251</i> | |

No consistent pattern is obvious between the proportion of the company offered and the average amount of underpricing. The Spearman correlation coefficient between these variables is negative 0.12, implying only 12% of the amount of underpricing can be explained by the proportion of the company offered for sale. These results are inconsistent with Leland and Pyle (1977) and Grinblatt and Hwang (1986) who found a significant negative relationship.

Company Offering New or Existing Shares.

Two means of listing a new company are through the sale of existing shares to the public and/or raising new capital through the issue of new shares.

Table 4-10 Underpricing by type of shares issued

| Type of Shares | Number | Average Underpricing | t-statistic | Median Underpricing | Wilcoxon |
|---|--------|----------------------|-------------|---------------------|----------------------------|
| New | 112 | 16.66% | 4.40*** | 12.39% | 4739 |
| Existing | 20 | 13.38% | 4.34*** | 8.60% | 196 |
| New & Existing | 8 | 6.52% | 1.05 | 8.39% | 25 |
| <i>Spearman Correlation Coefficient -0.07</i> | | | | | <i>Kruskal Wallis 4892</i> |

With such a small correlation coefficient, it is difficult to declare any strong statistical relationship. However, Table 4-10 does indicate that new share issues are underpriced by more in the market than existing shares sales.

There are two likely explanations for these results. Firstly, the underwriter may be forced to price the issue more fully to obtain the maximum value of funds for the sale of existing shares, as the wealth effects of existing owners are greater. Secondly, new shares are associated with a new company and carry a greater information asymmetry. The underwriter must underprice new shares by more than existing shares to ensure the maximum number of participants for the issue. This is consistent with Chemmanur's (1993) information asymmetry model.

Vendor's Stake Following Sale of Shares

Leland and Pyle (1977) argue that issuers can signal the quality of an IPO by retaining a relatively large stake. While Gale and Stiglitz (1989) point out that this signal is weakened by the possibility of the owner selling off a part of the ownership in the post-listing period. However, the New Zealand Stock Exchange Listing Rules do not require that directors and promoters of a company issue a statement in the prospectus setting out whether the promoters and directors have any intention to realise or sell any part of their

interest in the issue within a period after the IPO. Hence the Gale and Stiglitz criticism of the signalling role of retained ownership is less forceful than in situations where a formal intention is required.¹³ Following Leland and Pyle (1977), I expect underpricing will be significantly related to retained ownership.

When available, this variable seeks to measure the percentage of shares held by a vendor following the sale of existing shares. This characteristic does not measure the majority stake held by a vendor following the sale of new shares.

Table 4-11 Underpricing by Vendor's Stake following the sale of existing shares

| Stake | Number | Average Underpricing | t-statistic | Median Underpricing | Wilcoxon |
|-----------|--------|----------------------|-------------|---------------------|----------|
| 0% - 25% | 5 | -2.52% | -2.57** | -2.64% | 0 |
| 25%-50% | 15 | 20.23% | 1.99** | 12.34% | 107 |
| 50%-75% | 22 | 9.96% | 3.54*** | 11.36% | 217 |
| 75%- 100% | 8 | 7.49% | 2.73*** | 7.08% | 33 |

Spearman Correlation Coefficient 0.03 *Kruskal Wallis 325*

Although these results should be interpreted with caution, because of the small sample size and correlation coefficient, the level retained by the selling party appears to have an effect on the level of underpricing. Issues where the issuer retains more than 50% of the offer are likely to be priced more fully than issues where the level of holding by the selling company is below 50%. As with the issue of new or existing shares, this is likely to be due to the wealth effects of existing owners being greater [Leland and Pyle (1977)].

¹³ Beatty and Ritter (1986) make a similar point with respect to their 'observable' proxies for ex ante uncertainty.

Underpricing Measured by Involuntary or Voluntary Sell Down.

This variable measures whether the sale of existing shares was of a voluntary or involuntary nature, for example for regulatory reasons. Where this variable could be measured, the following statistics were obtained.

Table 4-12 Underpricing by involuntary or Voluntary Sell down

| Type | Number | Average Underpricing | t-statistic | Median Underpricing | Wilcoxon |
|-------------|--------|----------------------|-------------|---------------------|----------|
| Involuntary | 4 | 11.60% | 1.85* | 11.60% | 9 |
| Voluntary | 28 | 4.33% | 1.53 | 4.98% | 269 |

Spearman Correlation Coefficient 0.08 *Mann Whitney 448*

It is unsurprising to observe that the seller of the involuntary offering does not seek to maximise the full market value of the company. In many cases, involuntary offerings may seek to maximise full value but may have no choice and are forced to have a “fire sale” and sell quickly at adverse terms. The low level of underpricing for issues that are voluntary sell downs, while statistically insignificant, can be explained as the result of owners reducing information asymmetries in order to maximise their wealth from the voluntary sell down. Owners of an involuntary sell down may, for whatever reason, have no incentive to reduce information asymmetries [Chemmanur (1993)].

4.2.3 Market Condition

Hot and Cold Markets

Hot markets are expected to have average underpricing of more than cold markets [Beatty and Ritter (1986), Ibbotson, Sindelar and Ritter (1988)].

Table 4-13 Underpricing in Hot and Cold Markets

| Period | Number | Average Underpricing | t-statistic | Median Underpricing | Wilcoxon |
|--|--------|----------------------|-------------|--------------------------|----------|
| Hot Market | 66 | 21.28% | 4.11*** | 14.97% | 1721 |
| Cold Market | 82 | 12.55% | 3.65*** | 7.51% | 2687 |
| <i>Spearman Correlation Coefficient 0.12</i> | | | | <i>Mann Whitney 5722</i> | |

As expected, Table 4-13 indicates conclusively that hot issue markets raise the level of underpricing. This is consistent with overseas markets [Ibbotson and Jaffe (1975) and Ritter (1984)]. Appendix H has a commentary on why issues in hot issues markets are underpriced by more than cold issues markets.

There is also a good correlation of positive 0.59 between the number of issues in one month and the number of issues offered in the next month. This confirms Ibbotson, Sindelar and Ritter's (1988) analysis.

4.2.4 Underwriter Reputation

Underpricing by Reputation of the Underwriter

Vos and Cheung (1990, 1993) suggest that the reputation of the underwriter has a significant effect on the amount of underpricing of IPOs in New Zealand. Underwriters of small offerings in New Zealand have generally been medium to large sharebroking firms, rather than the typical investment bank found in the United States. Larger issues in New Zealand have been managed by underwriting syndicates from an investment bank.

To measure the effect of reputation on the effect of underpricing all lead underwriters are ranked in the sample period by the amount underwritten [Beatty and Ritter (1986)]. Where two or more lead underwriters have shared this duty, the total underwritten is split evenly across the lead underwriters. See Appendix I for a list of lead underwriters and their rank.

To measure the relationship between rank and the amount underpriced, the rank of each underwriter is regressed against the average amount underpriced for all issues that the underwriter performed.

A univariate regression of the 50 underwriters indicates a significant positive relationship between the reputation of the underwriter and the average amount of underpricing. The Pearson correlation coefficient between the rank of underwriter and the average underpricing is 0.19 - relatively strong. Hence, there appears to be a correlation between the reputation of the underwriter and the amount of underpricing.

The sample is then divided into two, by the size of reputation. Underwriters in the smaller size sample have a Pearson correlation with the average level of underpricing of 0.24. Underwriters with larger reputations have a Pearson correlation with the average level of underpricing of 0.04. This result is found to be more significant when only the lowest quarter of underwriters is considered. The lowest quartile of underwriters has a Pearson correlation between reputation and the average size of underpricing of 0.40.

In summary, the reputation of the underwriter is found to effect the size of underpricing, particularly for small issues. In these issues, which are shown on average to be more risky than larger issues, the level of underpricing is found to be positively related to the reputation of the underwriter.

This finding is consistent with other studies. Carter and Manaster (1990) argue that reputable underwriters tend to underwrite issues of larger firms. Also, larger firms tend to be associated with less underpricing. Chen and Mohan (1997) found that, using the Carter and Manaster underwriter reputation scale, the U.S. IPO market is, to a certain extent, segmented. They found this was particularly true for the low-reputation underwriting segment. My results are consistent with both of these studies, in so much as the New Zealand market indicates that lower quality issues are on average underpriced more and high quality underwriters tend to underwrite large issues. That is, although the New Zealand market may not be completely segmented, I do find some evidence of market segmentation, especially in the low-reputation underwriter market.

Market Shares of Underwriters

To measure whether there is a change in market share between underwriters the sample is split into two time periods. The sample is divided into the periods January 1982 to December 1986 and January 1987 to July 1997. These time periods represent approximately half of the total number of IPOs between January 1982 and July 1997, and also approximate pre and post the 1987 stockmarket crash.

Market Share for any one underwriter is defined as the total amount underwritten in each time period divided by the total value of all IPOs in each time period. Where any IPO was managed by more than one underwriter the total value of that IPO is divided between the underwriters involved.

Vos and Cheung state they can measure the market share or underpricing performance of 80 underwriting firms through two time periods. Underwriters of medium and small companies are often medium to large sharebrokers, rather than being investment banks, who tend to save their services for larger more prestigious companies. Consequently there are a large number of underwriters in this sample who also tend to disappear and appear as frequently as the companies they are underwriting. I can trace seven underwriters through the time periods chosen and these tend to be investment banks rather than sharebrokers.

Typical of a priori knowledge that individual sharebrokers, rather than investment banks, underprice issues, only seven underwriters can be traced through the two time periods masking the results a little dubious.

Table 4-14 Underwriters by Market shares and Average Underpricing

| Underwriters | 1982-1986 | | 1987-1997 | |
|------------------------------------|-----------|--------------|-----------|--------------|
| | Market | Average | Market | Average |
| | Share | Underpricing | Share | Underpricing |
| AMP Finance | 0.61% | -27.79% | 0.17% | 6.50% |
| CBA Merchant Finance | 1.87% | 26.04% | 0.04% | -21.99% |
| Hendry Hay McIntosh | 5.25% | 21.39% | 4.87% | 16.49% |
| Jordan Sandman Were/JB Were | 2.61% | 20.22% | 1.53% | 8.51% |
| Buttle Wilson | 13.47% | 8.67% | 4.40% | 31.27% |
| Jarden & Co /CSFB/First NZ Capital | 27.75% | 22.12% | 24.86% | 13.50% |
| Fay Richwhite / FR Partners | 0.57% | 21.39% | 42.02% | 6.97% |

Table 4-14 indicates that as Fay Richwhite attained more market share the average amount of underpricing decreased, and Buttle Wilson, who lost market share between the two time periods, underpriced by more in the second period than the first.

For all seven companies, there is no obvious pattern between the amount of underpricing in one period with the size of market share. This may be the result of the small number of underwriters that could be traced.

Amount of Brokerage paid to Underwriter and Broker

Various amounts of brokerage are payable to underwriters and brokers for their services. Presumably, more prestigious underwriters will command a greater percentage of fees.

The percentage of underwriting fees commanded may also represent the risk of the offer as seen by the underwriter. More risky offerings will command a higher payment for the investment bank to consider jeopardising their reputation.

Table 4-15 Underpricing by Percentage of Brokerage Fees Paid

| Percentage Paid | Number | Average Underpricing | t-statistic | Median Underpricing | Wilcoxon |
|-----------------|--------|----------------------|-------------|---------------------|----------|
| 0 - 1% | 2 | 15.13% | 1.56 | 15.14% | 3 |
| 1 - 2% | 7 | 46.80% | 1.87* | 25.64% | 23 |
| 2 - 3% | 19 | 22.99% | 2.47** | 13.61% | 182 |
| 3 - 4% | 47 | 11.50% | 2.39** | 6.71% | 790 |
| 4 - 5% | 27 | 8.54% | 1.76* | 5.41% | 264 |
| >5% | 28 | 13.08% | 3.17*** | 9.68% | 336 |

Spearman Correlation Coefficient -0.17 *Kruskall Wallis 1587*

There is no obvious relationship between the amount of underpricing and the brokerage paid. Figure 4-7 shows the spurious distribution of fee size to the size of the offer.

Chen and Mohan (1997) have combined underwriting fees and offer size in a measure called ‘underwriter spread’ as a proxy for asymmetric information. I comment on the use of this variable in Section 5.3.

Figure 4-7 Size of offer by fees paid



4.2.5 Contract Choice / Offer Mechanism

Open-Priced or Fixed-Price Offering

Open-priced offers are expected to have less average underpricing than fixed price offers.

Table 4-16 Underpricing by Offer Type

| Type of Issue | Number | Average Underpricing | <i>t</i> -statistic | Median Underpricing | Wilcoxon |
|---------------|--------|----------------------|---------------------|---------------------|----------|
| Fixed-Price | 142 | 16.67% | 5.33*** | 10.06% | 7867 |
| Open-Priced | 6 | 10.99% | 4.00*** | 8.67% | 21 |

Spearman Correlation Coefficient 0.03 *Mann Whitney 486*

As I mentioned in Section 3.1.5, there have only been six open-priced IPOs since this type of offering was introduced with the Telecom Corporation offer in June 1991. So, once again, these results should be interpreted with caution because of the small sample size, and low Spearman correlation and Mann Whitney statistic.

Nonetheless, as expected, open-priced issues reduce the level of underpricing. This is consistent with the hypotheses in Section 3.1.5 and Lee, Taylor and Walter (1996a, 1996b) and Benveniste and Wilhelm (1997).

Time Until Issue

A common proxy for fluctuations in the relative level of informed demand is the number of days between prospectus registration and exchange listing. This period averages 50 days for this sample (see Appendix E). Unlike Koh and Walter (1989) and Keloharju (1993), it is not possible to directly test Rock's (1986) model by observing the nature and extent of issue rationing on the offer date. However, as explained Section 3.1, those issues which close (and therefore list) most rapidly are expected to have the highest level

of informed demand. One would expect these issues to display relatively larger underpricing.

Table 4-17 Underpricing by time to issue

| Time Until Issue | Number | Average Underpricing | <i>t</i> -statistic | Median Underpricing | Wilcoxon |
|------------------|--------|----------------------|---------------------|---------------------|----------|
| <25 | 9 | 9.89% | 1.48 | 4.78% | 34 |
| 25-50 | 96 | 18.46% | 5.37*** | 11.80% | 3927 |
| 50-75 | 28 | 19.75% | 1.99* | 9.28% | 294 |
| >75 | 15 | 1.29% | 0.24 | 0.98% | 64 |

Spearman Correlation Coefficient -0.06 *Kruskal Wallis 3864*

The results presented in Table 4-17 indicate a relationship between the level of underpricing and the time between registration and listing. This is consistent with the results of Koh and Walter (1989) and Keloharju (1993). The results also support the existence of Rock's (1986) "winners' curse" faced by uninformed investors in the New Zealand market, with underpricing increasing the greater the delay between registration of the prospectus and listing.

4.2.6 Conclusions from Univariate Analysis

The level of underpricing measured in this study is consistent with other markets but smaller than the level measured in previous studies of this market.

While the existence of IPO underpricing is a common feature in the New Zealand market, this univariate analysis does not offer more than a few clues as to why some issues are underpriced by more than others. It seems that IPO underpricing in New Zealand is a rather sporadic occurrence and common characteristics of IPOs explain only a limited amount of the underpricing phenomenon. However, there is enough evidence presented in this chapter to reject the null hypothesis that IPO underpricing is independent of *any* issue related factors.

While underpricing is evident throughout the period, my results suggest that evidence of underpricing may lead to the decision to go public for many issues. A period of high underpricing (eg most of 1986) is followed by a rise in IPO frequency during 1987. This relationship, although only tentative, is consistent with evidence summarised by Ibbotson, Sindelar and Ritter (1988), who suggest that 'hot issue' markets are not marked by high IPO volume, but rather that such increases in volume occur shortly thereafter.

This study finds some evidence of underwriter segmentation of the New Zealand IPO market, a result consistent with both Chen and Mohan's (1997) and Carter and Manaster's (1986) analysis of the U.S. market. Analysis of the offer mechanism in New Zealand highlights the existence of Rock's (1986) "winners' curse" and Chemmanur's (1993) information asymmetry hypotheses.

The results provide support for the existence of the *ex ante* uncertainty arguments of Beatty and Ritter (1986), especially whether the firm going public is a going concern or a start-up. However, the results are not supportive of Leland and Pyle's (1977) retained ownership hypothesis.

This study finds that the market values issues involving the repayment of existing debt more fully than issues where the company is raising new capital. The results also offer some support for the signalling hypotheses of Leland and Pyle (1977) and Down and Heinkel (1984). This study finds no relationship between the issuers industry sector and underpricing, which contradicts Su and Fleisher (1997), Ritter (1984) and Mauer and Senbet (1992).

The patterns observed for the various IPO characteristics investigated are generally independent of the analysis of the average or the median. Therefore, the assumption of a normal underpricing distribution made by other studies, while false, does not generally effect the trends of IPO underpricing investigated in this study.

The results of this univariate analysis are used as a basis for construction of the multivariate model in the next section.

4.3 The Underpricing Prediction Model

Some well-known variables used to explain cross-sectional differences in IPO initial returns are:

- LNIPPOSZ = logarithm of IPO size measured in New Zealand dollars
- TIMEIPO = number of days elapsed between the announcement of an IPO and the first-day market trading
- PROCEEDS = dummy variable measuring whether proceeds of the IPO are to retire debt or raise new equity
- PROPRTN = the proportion of the company offered in the IPO
- BROKERAGE = level of brokerage paid as a percentage of offer proceeds
- VENDORSTKE = vendor stake following the IPO
- LISTED = dummy variable for whether the IPO is for a new or existing company
- PRE1987 = dummy variable for whether the IPO is before or after the 1987 share market crash
- SHARETYPE = dummy variable for whether the shares offered are new or existing
- HOTCOLD = dummy variable for whether the IPO occurs in a hot or cold market
- INDUSTRY = dummy variable for whether the company listing operates in a durable or non-durable goods business or in other industries
- OPENFIXED = dummy variable for whether the IPO is an open-priced or fixed-price issue
- REPN (K) = reputation dummies, $K=1,2,\dots,50$ ¹⁴

¹⁴ This is the ranking method suggested by Beatty and Ritter (1986) where lead underwriters are ranked by their reputation, which is determined by the size of issues underwritten. Rankings for New Zealand lead underwriters are presented in Appendix I.

Descriptive statistics for the above variables are presented in Section 4.2 Results of Univariate Analysis. The correlation matrix for the variables is presented in Table 3-1.

The dependent variable is LNIPORETN, the natural logarithm of the market adjusted first day return (underpricing). The benchmark regression is

$$\begin{aligned} \text{LNIPORETN}_i = & \alpha_0 + \alpha_1 \text{LNIPOSZ} + \alpha_2 \text{TIMEIPO} + \alpha_3 \text{PROCEEDS} + \\ & \alpha_4 \text{PROPRTN} + \alpha_5 \text{BROKERAGE} + \alpha_6 \text{VENDORSTKE} + \\ & \alpha_7 \text{LISTED} + \alpha_8 \text{PRE1987} + \alpha_9 \text{SHARETYPE} + \alpha_{10} \text{HOTCOLD} + \\ & \alpha_{11} \text{INDUSTRY} + \alpha_{11} \text{OPENFIXED} + \alpha_{12} \text{REPN(K)} + \epsilon_i \end{aligned}$$

This study also develops a model for market adjusted 30 day returns (the dependent variable is LNIP030DAY). This model aims to test the robustness of the prediction variables chosen in the initial returns model with respect to the effect of perceived “market ebullience” surrounding a new issue versus “market equilibrium” one month hence. That is, is the initial returns model representative of an equilibrium result? This is a motivation for the analysis of long-run returns of IPOs by Ritter (1991), Keloharju (1993), Loughran, Ritter and Rydqvist (1994), and Lee, Taylor and Walter (1996b).

Two additional models (not presented) are developed with unadjusted market initial and 30-day returns to again test the robustness of the variables chosen. These multiple regressions select the same variables as the market-adjusted model with similar predictor statistics.

Table 4-18 Pearson Correlation Matrix for Variables to Explain IPO Initial Returns

(p-values are presented in brackets)

| | LNIPORETN | LNIP030DAY | LNIP0SZ | TIMEIPO | PROCEEDS | PROPRTN | BROKERAGE | VENDORSTKE | LISTED | PRE1987 | SHARETYPE | HOTCOLD | INDUSTRY | OPENFIXED | REPN |
|------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|-------------------|--------------------|------|
| LNIPORETN | 1 | | | | | | | | | | | | | | |
| LNIP030DAY | 0.7209 (0.000) | 1 | | | | | | | | | | | | | |
| LNIP0SZ | -0.1736 (0.089) | -0.0981 (0.387) | 1 | | | | | | | | | | | | |
| TIMEIPO | -0.0405 (0.688) | -0.1018 (0.354) | -0.2029 (0.015) | 1 | | | | | | | | | | | |
| PROCEEDS | 0.1511 (0.181) | 0.1867 (0.136) | -0.1153 (0.208) | 0.0480 (0.601) | 1 | | | | | | | | | | |
| PROPRTN | -0.0529 (0.599) | -0.0207 (0.851) | 0.0902 (0.286) | -0.0660 (0.425) | -0.0660 (0.425) | 1 | | | | | | | | | |
| BROKERAGE | -0.0337 (0.754) | -0.1375 (0.246) | -0.0529 (0.549) | -0.1205 (0.170) | -0.1205 (0.170) | -0.1688 (0.048) | 1 | | | | | | | | |
| VENDORSTKE | -0.1931 (0.266) | 0.0553 (0.768) | 0.1841 (0.201) | -0.0740 (0.610) | -0.0740 (0.610) | -0.6886 (0.000) | 0.2014 (0.179) | 1 | | | | | | | |
| LISTED | 0.2607 (0.008) | 0.2164 (0.047) | -0.1649 (0.050) | 0.0128 (0.877) | 0.0128 (0.877) | 0.2438 (0.004) | 0.0107 (0.904) | -0.1736 (0.228) | 1 | | | | | | |
| PRE1987 | -0.2122 (0.033) | -0.2293 (0.035) | 0.5829 (0.000) | -0.2364 (0.004) | -0.2364 (0.004) | -0.1251 (0.126) | 0.2501 (0.004) | 0.3828 (0.006) | -0.3350 (0.000) | 1 | | | | | |
| SHARETYPE | 0.0709 (0.481) | 0.0636 (0.563) | -0.3900 (0.000) | 0.1903 (0.021) | 0.1903 (0.021) | 0.0972 (0.235) | 0.0168 (0.849) | 0.0525 (0.717) | 0.3298 (0.000) | -0.5032 (0.000) | 1 | | | | |
| HOTCOLD | 0.2369 (0.017) | 0.2738 (0.011) | -0.2358 (0.005) | 0.1199 (0.147) | 0.1199 (0.147) | -0.0411 (0.616) | -0.1188 (0.176) | -0.0535 (0.712) | 0.3605 (0.000) | -0.6025 (0.000) | 0.3546 (0.000) | 1 | | | |
| INDUSTRY | 0.0200 (0.843) | -0.0597 (0.587) | -0.0596 (0.481) | -0.0608 (0.463) | -0.0608 (0.463) | 0.1548 (0.058) | 0.0041 (0.963) | -0.0450 (0.587) | 0.2094 (0.011) | -0.0450 (0.587) | 0.1773 (0.031) | 0.0948 (0.252) | 1 | | |
| OPENFIXED | -0.1422 (0.156) | -0.1157 (0.292) | 0.4188 (0.000) | -0.0900 (0.277) | -0.0900 (0.277) | -0.0651 (0.427) | 0.0399 (0.651) | 0.3061 (0.000) | -0.1234 (0.074) | 0.3061 (0.000) | -0.2194 (0.007) | -0.1844 (0.025) | 0.0744 (0.369) | 1 | |
| REPN | 0.2392 (0.031) | 0.3713 (0.003) | -0.5107 (0.000) | 0.3874 (0.000) | 0.3874 (0.000) | -0.0505 (0.575) | -0.2156 (0.022) | -0.4044 (0.000) | 0.1641 (0.074) | -0.4044 (0.000) | 0.1975 (0.031) | 0.2013 (0.028) | 0.0089 (0.923) | -0.2116 (0.021) | 1 |

4.3.1 The Underpricing Prediction Model

Table 4-19 presents my initial underpricing multiple regression model and also the 30-day returns model.

Table 4-19 Underpricing Prediction Model

| Variable ¹⁵ | Initial Underpricing | | 30-Day Underpricing | |
|-------------------------|----------------------|-------------|---------------------|-------------|
| | Coefficient | t-statistic | Coefficient | t-statistic |
| Intercept | -2.217 | -10.19*** | -2.247 | -7.98*** |
| TIMEIPO | -0.004 | -1.70* | -0.012 | -2.46** |
| HOTCOLD | 0.317 | 1.69* | 0.644 | 1.92** |
| REPN(k) | 0.019 | 2.04** | 0.047 | 3.58*** |
| LISTED | 0.371 | 2.56*** | | |
| R ² | | 0.1312 | | 0.2555 |
| Adjusted R ² | | 0.0992 | | 0.2176 |
| F-statistic | | 3.126*** | | 6.784*** |
| Number of IPOs | | 80 | | 63 |

Results from the diagnostic testing are presented in Appendix K. The partial residual plots show no sign of any patterns which necessitate data transformations. The regression plot shows an excellent model fit and the Durbin-Watson test indicates a random sample. The Leverage and Cook's and Mahalanobis distances indicate only a handful of outliers. Significant outliers are Carborundum New Zealand, Waikato Stud, Cardrona Ski Lodge, Clearwood Thorobred Stud, Commodore Computer Corporation, Lakeland Properties, Agricola Resources, Arahi Properties, Paladin Investments, and Gaze Holdings. All these companies were small, speculative issues, predominantly listing during the "hot" market periods of the 1980s. In summary, the regression diagnostics are very good and indicate a robust model fit.

¹⁵ Adjusted for heteroscedasticity using the White (1980) procedure.

4.3.2 Comment on the Model

The model incorporates the four strongest predictors apparent in the univariate analysis, namely: the existence of a “winners’ curse” in the offer mechanism, the influence of the market conditions prevailing prior to the issue, ex ante uncertainty of the issuing firm, and the effect of underwriter reputation. Thus, the model is an intriguing combination of information asymmetry, ex ante uncertainty, underwriter reputation and market conditions hypotheses.

This model is robust under all the regression diagnostic tests performed. The adjusted R^2 of 10% is comparable to those found in the literature on IPO underpricing. In particular Lee, Taylor and Walter (1996b) report an adjusted R^2 of 13%, while Chen and Mohan report an adjusted R^2 of 12%. The predictor statistics chosen in the 30 day model are the same, excluding the variable proxying ex ante uncertainty (LISTED). This is surprising given that it was the most significant independent variable in the initial underpricing model. However, the increased significance level of the remaining three predictor variables in the 30 day model emphasises their explanatory of underpricing in New Zealand.

Previous studies have used multivariate models to explain various underpricing hypotheses. For example, these studies develop a signalling model or a reputation model to try to explain these underpricing hypotheses. This study attempts to do this in the univariate analysis section. This model has been developed to be used as a prediction tool, using the factors most influential in the New Zealand IPO market. The combination of variables presented is unique in the IPO literature.

4.3.3 Use of the Model

Unfortunately, although the regression coefficients of the model are statistically significant and the regression diagnostics are excellent, the R^2 is too low for the model to be used as a prediction tool – a problem common to most financial models! This suggests that the model may be more helpful in understanding reasons for underpricing than for the prediction of underpricing.

However, if market participants are comfortable with the low R^2 , it is important to note that the model has a couple of moving parts to it that need to be regularly updated. The underwriter rank, presented in Appendix I, should be updated after each new issue to account for the relative changes in ranking. The market conditions variable needs to be updated at the end of each calendar year. This variable is an ex post measure of market conditions, creating the possibility of mis-assignment during the year. The default value of this variable should be cold, consistent with Ibbotson, Sindelar and Ritter's (1988) findings.

5. Conclusions

5.1 Underpricing In New Zealand

This study provides further evidence on the underpricing of IPOs in New Zealand. It finds IPOs in New Zealand to be underpriced on average by 16.44% (median 10.05%). This level of underpricing is lower than previous studies of the New Zealand market, but consistent with other studies of international markets.

This study also provides a thorough analysis of the large extent of underpricing hypotheses with respect to underpricing in New Zealand. This analysis makes two contributions to the existing IPO literature. First, it demonstrates a highly significant statistical relationship between a proxy for informed demand and underpricing, as suggested by the asymmetric information model of Rock (1986). It also demonstrates strong support for the effect of market conditions suggested by Ritter (1980) and Ibbotson, Sindelar and Ritter (1988), and evidence of Rock's (1986) "winners' curse" existing in the offer mechanism for New Zealand IPOs. It also finds some evidence of underwriter segmentation in the New Zealand IPO market, consistent with Chen and Mohan's (1997) and Carter and Manaster's (1986) analysis of the U.S. market.

Retained ownership and many of the proxies suggested for ex post uncertainty are not found to be evident in the New Zealand market. While retained ownership, suggested in the signalling model of Leland and Pyle (1977), is statistically related to underpricing, the economic significance of this relationship is low. However, this study does find evidence to support Beatty and Ritter's (1986) ex ante uncertainty arguments, relating to whether the issuing company is a going concern or a start-up.

Secondly, this study attempts to provide an empirical model of underpricing in New Zealand which can be used by market participants to predict future underpricing for New Zealand IPOs. Unlike Vos & Cheung's (1990, 1993) reputation model, this model has been set up to be empirically tested.

5.2 Assessment of the Underpricing Prediction Model

Unfortunately, the multiple regression model developed in this study has an R^2 which is too low to be recommended to market participants as a tool for predicting underpricing. The model, while robust under regression diagnostic testing, can only explain 13 % of underpricing. The model does however emphasise the findings of the univariate analysis: the existence of Rock's (1986) "winners' curse" in the offer mechanism, ex ante uncertainty of the issuing firm, market segmentation of underwriters, and the conditions prevailing in the market at the time of issue.

The multiple regression model is:

$$\begin{aligned} \text{LNIPORETN}_i = & -2.217 - 0.004 \text{ TIMEIPO} + 0.317 \text{ HOTCOLD} + 0.371 \text{ LISTED} \\ & + 0.019 \text{ REPN}(k) \end{aligned}$$

5.3 Areas of Further Research

This study acknowledges that there are three areas of additional research which may form part of future studies of the New Zealand IPO market.

Offer Mechanism

This study is unable to fully test this proxy for information asymmetry in New Zealand at this time due to the relatively recent introduction of constrained open-priced issues in NZ. The likely introduction of unconstrained open-priced issues is another angle worth investigating. Benveniste and Wilhelm (1997) and Loughran, Ritter and Rydqvist (1994) find this auction mechanism effectively eliminates underpricing. I would expect a proxy for the offer mechanism to form part of the multivariate model as more open-priced issues occur in New Zealand.

Oversubscription

The influence of oversubscriptions investigated by Lee, Taylor and Walter (1996a) and Koh and Walter (1989) hasn't been able to be measured for this sample.

Lee, Taylor and Walter (1996a) believe the level of oversubscription is a direct measure of the total demand for the issue. Providing uninformed demand is reasonably uniform, the oversubscription rate is suggested as a proxy for informed demand. Lee, Taylor and Walter find that, in accordance with Rock (1986), the higher the level of informed demand the higher the initial underpricing.

Lee, Taylor and Walter find that high levels of oversubscription are frequently evident in Singapore IPOs. They believe oversubscription can be described as informed demand expansion following ex ante rational price setting in the prospectus, in a market setting where investor demand for an IPO is not constrained by the bias in the allocation methods used by issuers or underwriters.

Although Rule 7.1.12 of the New Zealand Stock Exchange Listing Rules states that "Every offering document shall state the method of dealing with oversubscriptions, and the maximum amount of oversubscriptions which will be accepted," Rule 7.14.3 states that "If an offer of securities is oversubscribed, the issuer shall make no announcement of that oversubscription unless that announcement specifies the precise percentage by which the offer has been oversubscribed." It has therefore been difficult to obtain information on the level of oversubscription because there is no formal obligation to provide information.

Further investigation may find more data, or there may be a rule change that obligates issuers to mandatorily disclose the oversubscription level.

Underwriter Spread

Underwriter spread is computed by dividing the underwriter fees by the gross proceeds of the offering. Chen and Mohan (1997) believe that based on the asymmetric information hypothesis, underwriter spread reflects the pricing of uncertainty and as such, it is related to IPO underpricing. Chen and Mohan argue that underwriters have essentially two ways to price the issuing firm's risk, directly (underwriter spread) and indirectly (underpricing), and thus, underwriter spread and underpricing are jointly determined. It may be worth testing their hypothesis in the New Zealand market.

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Appendix A - Rock's (1986) Model

Let Z denote the number of shares offered and p the price per share. Let V be true value per share (revealed instantly in the after market), where V is a random variable with known cumulative distribution $F(V)$ and mean value $E(V)$. Informed investors know V ; the firm and the uninformed do not. Informed investors spend $I > 0$ on shares if $p < V$, but have zero demand if the issue is overpriced ($p > V$). Uninformed investors, of whom there are N , each invest a fraction T^* of their wealth on the issue. Each uninformed investor has wealth equal to 1, and any wealth not invested in IPO shares is put in a riskless, zero return security. Hence, this model is one of partial equilibrium in which other financial markets play no real role. Total dollar demands for IPO shares are thus:

$$\begin{array}{ll} \text{a) } NT^* + I & \text{if } p < V \\ \text{b) } NT^* & \text{if } p > V \end{array} \quad (10)$$

When shares are underpriced, orders by informed investors compete with those of uninformed investors; yet when shares are too expensive, the uninformed are the only bidders. Rationing occurs when orders exceed the supply of shares. From the investor's point of view, the relevant issue is the difference in probabilities of receiving shares when shares are good versus when they are bad. How the rationing scheme works is critical. If ordering shares is costless, informed investors will order shares of any good offering ($p < V$) no matter how low the probability of an allocation. The uninformed investors, however, cannot distinguish good offerings from bad. Hence, they will be concerned about the relative probabilities of receiving allocations of good versus bad shares. These probabilities in turn depend on the rationing rule. Rock assumes shares are rationed in purely random fashion, total orders being filled by lottery, so the resulting allocations show no favoritism between informed investors and uninformed investors. Such a scheme implies that the probability an uninformed investor gets shares in a good offering, denoted b , is less than the probability b' of getting shares in a bad offering: $b < b'$. This immediately illustrates that pricing shares at their expected value $E(V)$ will eliminate uninformed investors from the market, as they would be more likely to get bad shares, producing losses on average.

The above reasoning shows that participation by uninformed investors must require underpricing. The conclusion, though, is itself insufficient to explain why underpricing actually occurs. First, reducing prices may not work in attracting uninformed investors since, as offer proceeds fall, the informed demand I can soak up a larger portion of the offering. This increases the adverse selection, dissuading uninformed investors from placing orders. Second, it must be argued that price decreases have their expected effect of stimulating uninformed demand. This is important because one must explain why participation by uninformed investors is valuable to the issue. Since the issuer must underprice to attract orders from uninformed investors, uninformed investor participation must be necessary or valuable to induce the issuer to seek it.

To solve the problems mentioned above, Rock first analyses the wealth allocation (investment) decision of an uninformed investor. Given that such an investor believes the probabilities of receiving allocations are b_e in the good state ($V > p$) and b_e' in the bad state ($V < p$), the investor's end of period expected utility is:

$$\begin{aligned} EU = & b_e(1 - F(p)) E[U(1 + T(p^{-1} V - 1)) | V > p] \\ & + b_e'F(p)E[U(1 + T(p^{-1} V - 1)) | V \leq p] \\ & + [1 - b_e(1 - F(p)) - b_e'F(p)]U(1) \end{aligned} \quad (11)$$

where E denotes expectations, U is the utility function, $F(\cdot)$ is the cumulative distribution function of share values, and all wealth is invested in the riskless asset if no allocation is received. The uninformed investor selects a percentage T of the wealth to try to invest in IPO shares to maximise the expected utility. The optimal choice T^* will then depend on b_e , b_e' , and p , thus $T^* = T(b_e, b_e', p)$. One can show, in fact, that T^* depends not on b_e and b_e' individually, but only on their ratio (b_e/b_e'), which can be referred to as the rationing bias resulting from adverse selection with the filling of orders by lottery.

Next, Rock establishes the existence of an equilibrium with the following rational expectations property. Suppose that beliefs b_e and b_e' induce uninformed investors to invest a fraction of their wealth T in the IPO. This in turn determines the allocation probability b by the relationship:

$$b = \min ((pz/(NT^* + I)), 1) \quad (12)$$

Rock shows that $b = b_e$ for some b_e , so that there is a rational expectations equilibrium whenever $p < E(V)$.

Demonstrating that the level of uninformed demand increases as price decreases is somewhat more difficult, and here Rock relies on a “large market” assumption to simplify the analysis. When there are many uninformed investors, investment in the IPO represents only a small fraction of their wealth. Yet, if each investor has a smooth (differentiable) utility function, then each is approximately risk neutral with respect to such a small gamble. Hence, zero expected profits to uninformed investors determine their chances of getting good shares when bad shares are not rationed. This fact is useful in demonstrating that, as price is lowered, the probability of obtaining good shares b does not fall so rapidly that, despite the price decrease, uninformed demand declines.

Appendix B - Baron's (1982) Principal-Agent Model for Underpricing of IPOs

Proceeds from the sale of shares x depend on share price p , investment bank effort (promotion) e , and market conditions θ . Market conditions are unknown at the time the contract is formulated; yet, the agent (banker) sees an informative signal δ that affects the distribution of θ . Thus, the probability distribution $g(x | p, e, \delta)$ summarises the distribution of proceeds x given p , e , and δ . Further, $x(p, e, \theta)$ is increasing in effort e , and increases in effort yield increases in proceeds in the sense of first degree stochastic dominance.

Let d be the bank's claim (which may be untruthful) about its market information δ . The compensation to the investment bank is $s(p, d, x)$. Hence, the bank first learns about market conditions δ , and reports a value d to the issuer (principal). If the issuer proceeds with the offer, it selects a price $p(d)$ based on the bank's "advice" d . The bank privately selects its level of promotion activity e to serve its interests. Payment to the bank is then $s(p, d, x)$, and returns to the issuer are just $(x - s)$.

The bank acts in its own interests given the contract offered by the issuer. Since promotion is costly, write the bank's returns as $s - c(e)$ where $c(e)$ is the cost associated with a promotion level e . The bank, therefore, selects its effort e and reports on market conditions d to maximise its expected returns given: (1) its information δ , (2) the pricing rule $p(d)$ selected by the issuer, (3) its costs $c(e)$, and (4) the compensation contract (formula) $s(p(d), d, x) = s(d, x)$ selected by the issuer/principal. The issuing firm knows all this and takes account of it in making its plans.

Because of the inherent mathematical complexity of principal-agent models, derivation of an optimal contract is often simplified by using the so-called "revelation principle," a mathematical device that facilitates analysis. As an example, suppose a government (principal) collects income taxes from citizens. The citizens report their incomes and are taxed accordingly. Suppose the government decides that taxes should be higher for those

making \$60,000 than for those making \$40,000. Further, imagine that the government cannot tell the difference between people making \$40,000 and \$60,000 (although other incomes can be observed), and solely relies on citizens' reports. If citizens are purely self-interested, all those making \$60,000 will claim they make \$40,000, yielding tax receipts at the \$40,000 rate. The revelation principle notes that, in any such situation, there is another tax system that yields the same tax revenues but induces everyone to tell the truth about their income. In this case, the government need only tax \$40,000 and \$60,000 incomes at the same level (in dollars). Then the same revenue would be raised, and those making \$60,000 would have no reason to lie about it.

The revelation principle is important because it allows the analyst to restrict attention to contracts that induce the agent to tell the truth. Any lying is taken into account and made unnecessary by the design of the contract. This principle says nothing substantive about how contracts look, but merely simplifies their analysis.

Technical complications aside, Baron proceeds to analyse the principal's problem. The principal tries to design a contract $s(\delta, x)$ that specifies agent compensation based on any private information δ and proceeds x and a pricing rule $p(\delta)$ that establishes price per share based on the agent's (truthful) report δ in order to maximise expected proceeds from the offering. Formally, the problem has the form:

$$\max_{p(\delta), s(\delta, x)} \int (\int (x-s)g(x|p(\delta), e(\delta, \delta), \delta)dx)f(\delta)d\delta \tag{14}$$

s.t.

- (i) $s(\delta, x) - c(e(\delta, \delta)) \geq s(d, x) - c(e(d, \delta))$
- (ii) $e(d, \delta)$ maximises the agent's returns
- (iii) expected agent returns exceed a minimum level

Expression (x) indicates that the issuer is to select a pricing rule $p(\delta)$ and contract $s(\delta, x)$ to maximise expected returns $(x-s)$ from the offering. The constraints represent the requirements of truthful revelation of δ by the agent and agent rationality. Constraint (i)

implies that if δ is the true signal, then claiming that the signal is δ must be at least as good for the agent as claiming that it is d not equal to δ , no matter what δ is. The term $e(d, \delta)$ is defined in constraint (ii): $e(d, \delta)$ is that level of effort that most benefits the agent, given the contracts and pricing rule p , when δ is the true market signal and d is reported to the principal. Constraint (iii) is a participation condition: the agent must expect at least some minimal returns to be willing to participate in the contract. Hence, the constraints collectively indicate that: (1) the agent will be given an incentive to tell the truth, (2) the agent will be self-beneficial, and (3) the agent is willing to work for the principal only when at least some minimum returns are expected to be received.

Several conclusions can be obtained from analysis of the problem in expression (14). First, since e and δ are not directly observed by the principal, the agent's choice of effort will not equal that level of effort which maximises total net benefits, i.e., moral hazard will arise. Even though the issuer knows this, it is typically too costly to give the agent incentives to work maximally. Inducing the agent to work harder (increase e) typically requires that the principal award the agent a larger share of the proceeds, a costly procedure. Additionally, truthful revelation by the agent usually requires costly distortions in the contract. Thus, one does not expect that the agent will behave in a manner that maximises total net benefits (proceeds minus effort costs).

Because of the great complexity of the model, Baron considers contracts having the special form $S(\delta, x) = S(\delta) + tX$, where t , $0 \leq t \leq 1$, is the share of the proceeds given to the banker. With this simplification a number of conclusions are possible. Note that $t = 1$ represents a firm commitment contract in which the investment banker receives all proceeds after a fixed payment to the issuer, while $t = 0$ approximately corresponds to a pure best efforts offering. Baron shows that with effort fixed at the "first best" level (that level that maximises total net benefits given δ), the optimal price $p(\delta)$ is lower than the net benefit maximising optimal price. This suggests that the model may explain underpricing.

Baron continues by analysing an example utilising relatively simple forms for the cost, utility, and proceeds functions, and a uniformly distributed market signal δ . These

simplifications allow several interesting propositions to be derived. The level of uncertainty the issuer faces with respect to the banker's information, given by the dispersion of the distribution of δ , is positively related to the willingness of the issuer to accept a lower price. Hence, uncertainty in this sense is positively related to underpricing. This conclusion, while derived under special assumptions, is quite generally plausible and is common to several types of IPO underpricing models. Further, this notion that greater uncertainty induces greater underpricing was expressed in very early analyses of IPO underpricing which did not utilise theoretical models.

Appendix C - The Signalling Model - Spence (1973)

Although the idea of signalling behaviour has seen wide application in financial analysis, the notion of signalling was first introduced by Spence (1973) in his analysis of the role of education in labour market behaviour. Spence questioned whether a worker's educational attainment should be legitimately rewarded by an employer even if the education was, in itself, totally "worthless" as far as job performance was concerned? Could not educational credentials themselves convey valuable information on the unobserved quality of the worker? Since virtually all workers can be expected to claim they are of high quality, mere assertions are unconvincing. Yet, high quality workers, if they know they are of high quality, have an incentive to try to prove this fact to employers, just as low quality workers may desire to masquerade as high quality employees. Is there any action high quality workers could take that would convince potential employers of their quality? Signalling models are concerned with this basic and widely applicable issue.

In Spence's education signalling model, it was assumed that good workers could obtain education at lower costs than poor workers. Although good workers are more valuable to employers and can command higher wages, bad workers are dissuaded from obtaining education because it is so costly for them that the wage gains of being taken for a good worker are insufficiently attractive. Spence showed that an equilibrium was possible in which good workers got education, bad workers did not, and educated workers received higher wages. Such an equilibrium is called "separating" because the unobserved "types" (characteristics) of participants are revealed by their actions. If, however, education costs differed little among workers, low quality workers might obtain education in order to appear to be good quality, destroying the value of the signal. In cases like this, workers' types are not credibly distinguished by their behaviour leading to a so-called "pooling" equilibrium in which all workers behave the same and are treated the same by employers.

The signalling problem is as follows. Market participants are assumed to differ in some unobservable but important way. Transactions among participants can produce increased welfare or other benefits. Participants with "good" characteristics would benefit if they

could somehow convince other participants of their quality. Hence, such participants seek forms of behaviour, called signals, that provide convincing proof of their value. Since participants with low quality characteristics could enjoy greater benefits if others incorrectly believed them to be high quality participants, any behaviour successfully used as a signal must be more costly to poor quality players to dissuade their charade.

Appendix D - Grinblatt and Hwang's (1989) Signalling Model for IPO Underpricing

Grinblatt and Hwang (1989) propose a three period world in which an entrepreneur owns some investment projects requiring a given, fixed investment at date 0 of \$K to pursue. The project yields cash flows in dates 1 and 2. Date 2 cash flow is $\mu + X_2$, where X_2 is some random variable with zero mean and variance $\sigma^2 > 0$, and μ is fixed and known to the entrepreneur. At date 1 a random, independent (ie., uninformative) cash flow of X_1 arises with zero mean and variance σ^2 . The entrepreneur is risk averse and, to diversify, wishes to market the project to the risk neutral public in an IPO. The entrepreneur (hereafter issuer) knows μ and σ^2 , while investors only know the distribution from which these values are drawn. If μ is "high," the issuer would like to prove this to investors. Unfortunately, the Leland and Pyle (1977) signal of the fraction of shares retained, denoted α , is not by itself a good signal of μ since investors do not know σ^2 . A large α , for example, might indicate high μ and large σ^2 , or lower μ and smaller variance. The larger the variance σ^2 , the greater is the cost of retaining shares to the risk averse issuer. Thus, the issuer would desire to inform investors when σ^2 is high in order to make the α signal informative and effective. Since two items of information need to be signalled, two signals are needed. Offer price p constitutes the other signal.

Without signalling, investors learn μ for free with probability θ , $0 < \theta < 1$, between dates 0 and 1. Otherwise, μ is revealed at date 2. The order of events is as follows. First, luck selects μ and σ^2 , and the issuer sees them. Then, the issuer offers a fraction $1 - \alpha$ of the firm to outsiders at price p at date 0. Investors accept or reject the offer. Then, investors learn μ with probability θ and learn nothing with probability $1 - \theta$. Date 1 arrives, and the issuer disposes of the remaining shares at the date 1 market price after the public realisation of date 1 cash flow X_1 . Date 2 then occurs, μ is revealed, and payoffs to investors are made. It is assumed everyone knows all this.

Since the issuer sells out at date 1, the selections of α and p are intended to maximise the expected utility U of date 1 wealth W_1 , which takes the simple quadratic form:

$$E(U(W_1)) = E(W_1) - (b/2) \sigma^2(W_1) \quad (15)$$

Here, b represents the issuer's risk aversion and $\sigma^2(W_1)$ the variance of the date 1 wealth. The issuer allocates initial wealth between shares retained in the IPO, a risk free asset, and a market fund, priced via the CAPM relationship. For simplicity, project returns are uncorrelated with the market.

Let $E(\mu|\alpha, p)$ be the investor's guess about μ given the signals α and p . (Investors are risk neutral; so they don't care about σ^2 except to the extent it allows them to interpret the signal α .) Investors initially buy $(1-\alpha)$ of the shares if $p < E(\mu|\alpha, p)$ and nothing otherwise. At period 1 the aftermarket exhibits price $p_1 = E(\mu|\alpha, p)$ if μ is not revealed, and $p_1 = \mu$ if it is.

If σ^2 were known, the Grinblatt and Hwang model would closely resemble Leland and Pyle (1977), producing similar conclusions. When σ^2 is not known, however, p can be used to signal this value. It becomes clear that this is possible only when it is recognised that there is a one-to-one correspondence between the signalling model in which investors use α and p to infer μ and σ^2 , and a signalling model in which they use α and the underpricing discount D to infer μ and σ^2 . Given this correspondence, Grinblatt and Hwang demonstrate that a signalling equilibrium exists that is fully separating: the signals α and p allow investors to infer μ and σ^2 for any firm. The signalling schedules used by investors and firms in equilibrium are:

$$(i) \quad \mu = \mu^L(\alpha) + [(1-\alpha)/(1-\alpha r)] D \quad (16)$$

$$(ii) \quad \sigma^2 = \sigma_L^2 + [(1-\alpha) r / (1-\alpha r) \alpha b] D$$

where D is the discount, $\mu^L(\alpha) = (-r^2) b\sigma_L^2 [\ln(1-r) + r] + K$, and σ_L^2 is the lowest project return variance among potential issuers. An equivalent statement in terms of α and p is available as well.

While derivation of equilibrium in the Grinblatt and Hwang signalling model is technically complex, the equilibrium itself has a number of intuitive and appealing properties. First, it is straightforward to show that high variance-projects are sold at larger discounts in equilibrium, a result consistent with empirical evidence and other competing theories. Further, given any variance of returns σ^2 , issuers with high value projects retain a greater fraction of shares α . Additionally, given σ^2 , underpricing is greater for higher value projects.

Appendix E - Missing Prospectus Offer Dates

Many firms who listed between 1982 and 1997 did not issue a prospectus with the Stock Exchange. Hence, no prospectus/offer date was available for these issues, although other information of the issue was available.

For the objective of increasing the sample size of this study the following proxy measure for missing prospectus dates was developed. For the 148 IPOs available, the average time an IPO takes to list, following the issue of a prospectus, is 50 days (with a standard deviation of 38).

To proxy the missing dates for the 39 IPOs for which all other information was available, the prospectus date was taken to be 50 days before the listing date. Consequently, the market return over the proxy offer date to the list date is calculated and underpricing measured. This has a notable effect on the results.

As Table A-1 indicates, the average underpricing in this period increases from 16.44% to 24.16%, still significant to the 1% level.

Table A-1 Initial Abnormal returns for IPOs, 1982-97

| | | |
|------------------------|---------|---------|
| Sample Size | 148 | 187 |
| Mean Abnormal Return | 16.44% | 24.16% |
| <i>t</i> -statistic | 5.47*** | 7.11*** |
| Standard deviation | 0.38 | 0.46 |
| Median Abnormal Return | 10.05% | 11.66% |
| Wilcoxon statistic | 8631 | 9542 |

An explanation for the higher underpricing is that the majority of issues for which prospectus dates are missing occur during times of hot markets. Hot markets generally have higher average underpricing than cold markets.

Thirty-two of the IPOs for which prospectus dates were missing occurred in hot markets and seven occurred in cold markets. This also infers that the average difference between offer and list date of 50 days may not be consistent throughout the sample period. The time period between offer and list dates in hot and cold markets is likely to differ.

Re-estimating the difference between the time from offer to list finds that the average time an IPO takes to list in hot markets is 55 days and in cold markets, 46 days. Taking account of these time periods the average underpricing is now found to be 22.83%, which is practically the same as before.

However, I am unable to increase the sample from 148 observations to 187 due to the large standard deviation observed for the proxies for the number of days from registration to listing. Although the inclusion of the extra IPOs increase the average level of underpricing measured notably, I am comfortable with the level of underpricing relative to Camp (1997), Vos and Cheung (1993) and Firth (1997) who have underpricing levels in the range 25.87-32.04%. These three studies all have data sets encompassing the bull markets of the 1980s and confirm the hot market argument of Appendix H regarding higher average underpricing in hot periods.

Appendix F - Relative Period in the Market

This study has used a relative period in the market dummy variable to test whether the premium offered in periods of “Hot Activity” differs from periods of “Cold Activity.”

The market experienced periods of dramatic change over the period of this investigation. Table A-2 shows the market index¹⁶ at the beginning of each year and the return on the market in that year.

Table A-2 Market Index Returns during Sample Period

| Year | Market Index (Beginning of Year) | Market Return over Year (%) |
|-------------|-------------------------------------|-----------------------------|
| 1980 | 357 | 53.50% |
| 1981 | 548 | 27.42% |
| 1982 | 698 | -15.65% |
| 1983 | 589 | 120.20% |
| 1984 | 1,297 | 14.65% |
| 1985 | 1,487 | 28.85% |
| 1986 | 1,916 | 97.34% |
| 1987 | 3,781 | -48.45% |
| 1988 | 1,949 | -5.70% |
| 1989 | 1,838 | 12.73% |
| 1990 | 2,072 | -41.80% |
| 1991 | 1,206 | 27.28% |
| 1992 | 1,535 | 3.13% |
| 1993 | 1,583 | 38.52% |
| 1994 | 2,193 | -12.70% |
| 1995 | 1,914 | 15.08% |
| 1996 | 2,202 | 7.55% |
| 1997 | 2,369 | |

¹⁶ The Market Index is derived from the Barclays daily price index from 1982 to 1987 and the NZSE 40 Capital Index from 1987 to 1997.

A “hot” period occurs when there are large bouts of trading on the stock exchange. As highlighted in Table A-2, the periods of “Hot Activity” are defined to be 1983, 1986 and 1987. 1983 and 1986 experienced large increases in the market index, and although 1987 shows a decrease in the Market index, this was a year of a peak and a large fall (the stock market crash of October 1987).

Appendix G - Option Prices

Underpricing is measured by the excess return of the listing company over the return on the market from the time an IPO is offered to the day it lists.

Company Return - Market Return = Underpricing

If the company return is undervalued the market return will dominate its effect and consequently the underpricing will be understated.

The difference between the measured underpricing of the offerings that include options and those that do not is approximately 8% in favour of those shares that do not have options issued free. If the value of the options issued in conjunction with the new shares increase the company return by more than 8%, the average underpricing measured by this study would understate the true level of underpricing.

The average level of underpricing of the sample including the 14 IPOs where no option pricing information was available (ie, underpricing reflects initial return on ordinary shares only) is measured at 15.47% (median 8.12%). These 14 IPOs are excluded from the final sample, raising the level of average initial underpricing measured to 16.44% (median 10.05%). The measurement error of including the 14 companies in the final sample ranges between 6% to 24%, depending on the statistical measure of the centre. This magnitude of error is too large to include these companies in the final sample.

Appendix H - Why Hot Market IPOs are Underpriced by More than Cold Market IPOs

Academic literature suggests that issues in “hot markets” are likely to be underpriced by more than issues in “cold markets.” Beatty and Ritter (1986) attributed this phenomenon to investment banks exploiting natural resource issues, by underpricing by more, in the hot market of 1980. Ibbotson, Sindelar and Ritter (1988) point to a recurring pattern of hot issue and cold issue markets, similar to the experience in New Zealand. Neither study formulates a hypothesis to why this phenomenon occurs.

Underpricing measures the difference between the IPO’s offer price and the price at which it closes on the first day that it lists. This is adjusted for movement in the market over the time period from offer date to list date. In hot markets we can expect the movement of the market to be substantially larger than movements in cold markets. But, the underpricing of IPOs that occur in hot markets is still substantially larger than the underpricing in cold markets when the effect of the market has been accounted for. Therefore, the company return, the percentage difference between offer price and list price, is larger in hot markets than cold markets.

Underwriting in the New Zealand market has traditionally taken the form of a fixed price offer. At the offer date, a prospectus is issued offering shares at the offer price that does not change until the company lists. Investors form valuations of the listing company in line with movements with the market. In a hot market investors will tend to value the new issue at a price higher than the price they may value the company in a cold market. There are two explanations for this phenomenon. First, that investors may consistently overvalue the market movement in hot markets, and secondly, in times of hot markets there is increased demand for issues and this drives up the after market price.

This study is unable to draw any conclusions with respect to market conditions on open-priced issues because all the open-priced issues in the New Zealand market have occurred in cold markets.

Appendix I - Lead Underwriters By Rank

Table A-3 Underwriter Rank

| Underwriter | Number Underwritten | Total Underwritten | Average Underpricing | Rank |
|--------------------------------|---------------------|--------------------|----------------------|------|
| Fay, Richwhite & Co | 11 | 1,837,456,232 | 3.74% | 1 |
| CS First Boston | 8 | 764,538,600 | 7.24% | 2 |
| Ord Minnet Ltd | 4 | 602,436,411 | 11.64% | 3 |
| Jarden & Co | 14 | 416,777,345 | 17.86% | 4 |
| Buttle Wilson & Co | 12 | 393,228,100 | 22.07% | 5 |
| Goldman Sachs & Co | 1 | 96,099,750 | 16.24% | 6 |
| Hendry, Hay McIntosh | 8 | 95,874,475 | 28.40% | 7 |
| Merrill Lynch & Co | 1 | 93,500,000 | 9.32% | 8 |
| Jordan, Sandman, Symthe | 8 | 76,538,502 | 14.51% | 9 |
| Doyle, Paterson, Brown | 2 | 76,001,000 | 14.53% | 10 |
| Clavell Capital Ltd | 4 | 50,025,000 | 4.04% | 11 |
| FAS Macquire | 1 | 50,000,000 | 21.39% | 12 |
| PDL Holdings | 1 | 42,492,500 | 9.46% | 13 |
| Forsyth Barr | 5 | 42,187,500 | -1.46% | 14 |
| ANZ McCaughan | 1 | 34,263,755 | 12.14% | 15 |
| South Pacific Merchant Finance | 4 | 18,960,000 | -11.66% | 16 |
| New Zealand Equities | 2 | 17,700,000 | 20.17% | 17 |
| Challenge Corporate Services | 2 | 15,500,000 | -7.25% | 18 |
| Charter Corporation | 3 | 14,700,367 | 21.76% | 19 |
| Ord O'Connor Grieve | 1 | 13,687,500 | -1.07% | 20 |
| Bain & Co | 1 | 13,500,000 | -12.20% | 21 |
| Craig & Co | 1 | 12,600,000 | 16.29% | 22 |
| Pembroke Securities | 1 | 12,500,000 | 15.06% | 23 |
| W.M.G. Yovich Ltd | 1 | 12,500,000 | 10.20% | 24 |
| Equiticorp | 2 | 9,554,500 | 85.94% | 25 |
| Renouf Group | 3 | 9,527,581 | 21.41% | 26 |
| AMP Finance | 3 | 9,500,000 | -16.41% | 27 |
| Saudi NZ Capital Corp | 2 | 7,675,000 | 11.55% | 28 |
| Francis, Allison, Symes | 1 | 7,500,000 | 21.39% | 29 |
| United and Commercial Holdings | 1 | 7,000,000 | 30.53% | 30 |
| CBA Merchant Finance | 2 | 6,999,000 | 13.53% | 31 |
| Hamleyn Group Ltd | 1 | 6,000,000 | 1.79% | 32 |
| Westpac | 1 | 5,940,000 | 24.96% | 33 |
| Paine Belcher | 2 | 5,900,000 | -13.79% | 34 |
| Edgen, Wignall & Co | 1 | 5,000,000 | 21.39% | 35 |

| | | | | |
|-----------------------------------|---|-----------|---------|----|
| Corporate Investments | 1 | 4,985,954 | 4.83% | 36 |
| H. Robert Wilson, Greenslade & Co | 2 | 3,347,313 | 31.56% | 37 |
| Apex Group | 1 | 3,320,000 | -26.70% | 38 |
| McCaughan, Dyson | 1 | 3,141,790 | 18.13% | 39 |
| Investment Finance Co | 1 | 3,000,000 | 21.39% | 40 |
| AIC Finance Corp | 2 | 3,000,000 | 21.39% | 41 |
| NZI Securities | 1 | 2,925,000 | 8.16% | 42 |
| Morrow & Benjamin | 1 | 2,799,900 | 13.25% | 43 |
| Miniskips (Australia) Ltd | 1 | 2,500,000 | 1.68% | 44 |
| Hamilton, Hindin, Greene | 1 | 2,400,000 | -8.47% | 45 |
| Development Finance Company | 1 | 2,241,415 | 81.62% | 46 |
| Greville & Co | 1 | 1,800,000 | -16.28% | 47 |
| Whiteman, McCaughan, Dyson Ltd | 1 | 1,650,000 | 21.11% | 48 |
| Franklin Holmes & Co | 1 | 1,600,000 | 50.03% | 49 |
| O'Connor Grieve | 1 | 1,500,000 | 43.67% | 50 |

Appendix J - New Zealand Issuance Procedures - Evidence of a “Winners’ Curse”

New issue arrangements constitute a fair game for investors. All applicants for a particular number of shares in an IPO have an equal probability of receiving an allocation. Unless explicitly stated in the prospectus, all applicants for a particular number of shares in an IPO have an equal probability of receiving an allocation. Underwriters do not generally selectively allocate shares to preferred clients when an issue is oversubscribed, but details of the rationing process are not obliged to be disclosed. Hence, demand may be dampened by a bias in allocation to preferred clients, ie the market might assume a “winners’ curse” exists in the New Zealand market.

New shares can be issued to the public when accompanied by a prospectus registered with the relevant New Zealand Stock Exchange (NZSE).¹⁷ The prospectus details the number of shares to be listed and the issue price, neither of which can be changed during the course of the issue. All shares must be sold (or taken up by the underwriter) prior to trading commencing on the stock exchange. The issuer (and underwriter) is committed to a price and quantity decided on well before listing actually occurs. “Red herring” prospectuses are not allowed, so that formalised pre-selling of the issue cannot take place until the prospectus is registered by the NZSE. This cannot occur without a price having been set and stated in the prospectus.

¹⁷ Companies were not required to issue a prospectus prior to a listing rule change following the 1987 crash.

The inability to change the issue price and/or the quantity represents an important difference with the prevailing U.S. environment, where subscription prices are often not determined until (non-binding) offers have been received from potential subscribers [Hanley (1993)]. To the extent that this information is disclosed or is leaked, informed investors' demand is revealed, thereby lowering the expected level of underpricing. Ritter (1987) observes that U.S. issuers face relatively low price uncertainty in setting the subscription price. The New Zealand method can be expected to increase heterogeneity in information availability between classes of investors. Restrictions on pre-selling should compound the importance of preferred clients for brokers and underwriters. Any 'informal' (and, strictly illegal) pre-selling of New Zealand IPOs would be confined to a select group, thereby reinforcing the distinction between informed and uninformed investors. Rock's (1986) model of underpricing relies on this type of heterogeneity, while the lack of widespread pre-selling rules out the explanation for underpricing offered by Benvensite and Spindt (1989), who model underpricing as a 'reward' revelation of information during the pre-selling period.

The form of underwriting agreement used for New Zealand IPOs also contributes to an expectation that IPO underpricing and the winners' curse are related. Ritter (1989) argues that relatively risky IPOs use best efforts underwriting to reduce expected underpricing through reduction in the winners' curse faced by uninformed subscribers. Provided full subscription requires more funds than are available from uninformed investors alone, then best efforts underwriting effectively pre-commits the issuer to withdraw the offer if total demand is insufficient to meet a minimum issue condition. As New Zealand underwriting involves a stand-by arrangement, unlike the diversity of underwriting agreements evidenced for U.S. IPOs [Booth and Smith (1986)], this increases the probability that uninformed investors face a winners' curse.

Appendix K - Multivariate Model Diagnostic Analysis

Collinearity Diagnostics

Table A-4 Collinearity Diagnostics

| Number | Eigenvalue | Collinearity Index | Variance Proportions | | | | |
|--------|------------|--------------------|----------------------|--------|---------|--------|--------|
| | | | Constant | REPN | TIMEIPO | LISTED | REPN |
| 1 | 3.6486 | 1.00 | 0.0158 | 0.0205 | 0.0173 | 0.0114 | 0.0234 |
| 2 | 0.5515 | 2.57 | 0.0092 | 0.0962 | 0.1334 | 0.2890 | 0.2098 |
| 3 | 0.3502 | 3.23 | 0.0080 | 0.0028 | 0.0028 | 0.5437 | 0.7574 |
| 4 | 0.2736 | 3.65 | 0.1588 | 0.8680 | 0.2019 | 0.0009 | 0.0039 |
| 5 | 0.1760 | 4.55 | 0.8081 | 0.0125 | 0.6446 | 0.1441 | 0.0056 |

Residuals

Table lists the outliers of the initial returns multiple regression model identified by the relevant diagnostics tests.

Table A-5 Model Outliers

| Company | Leverage | Cook's Distance | Mahalanobis Distance |
|-----------------------------|----------|-----------------|----------------------|
| Carborundum New Zealand | 0.0965 | 0.0200 | 7.6211 |
| Waikato Stud | 0.0831 | 0.0487 | 6.5712 |
| Cardrona Ski Lodge | 0.0727 | - | 7.7407 |
| Clearwood Thoroughbred Stud | 0.0908 | - | 7.1715 |
| Commodore Computer Corp. | 0.0937 | - | 7.4038 |
| Lakeland Properties | 0.1042 | - | 10.8229 |
| Agricola Resources | 0.0877 | 0.0091 | 6.9243 |
| Arahi Properties | 0.0878 | 0.0028 | 6.9326 |
| Paladin Investments | 0.0823 | 0.0347 | 6.5052 |
| Gaze Holdings | 0.1300 | 0.0025 | 10.2673 |

Sample Randomness -

Durbin-Watson Test = 2.085

Figure A-1 Partial Residual Plot of Initial Underpricing and Market Conditions

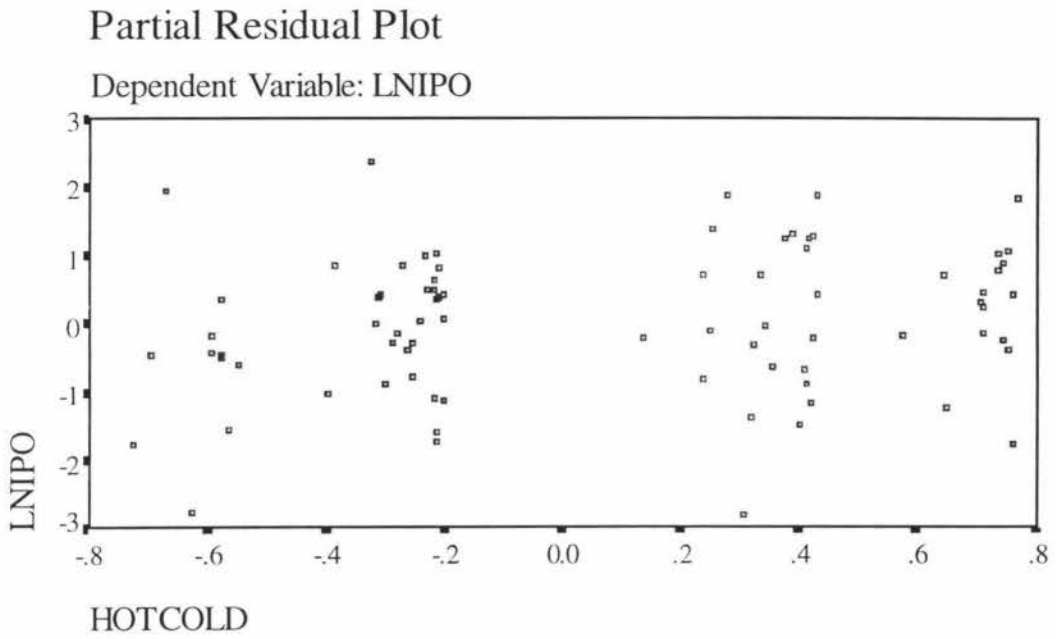


Figure A-2 Partial Residual Plot of Initial Underpricing and Underwriter Reputation

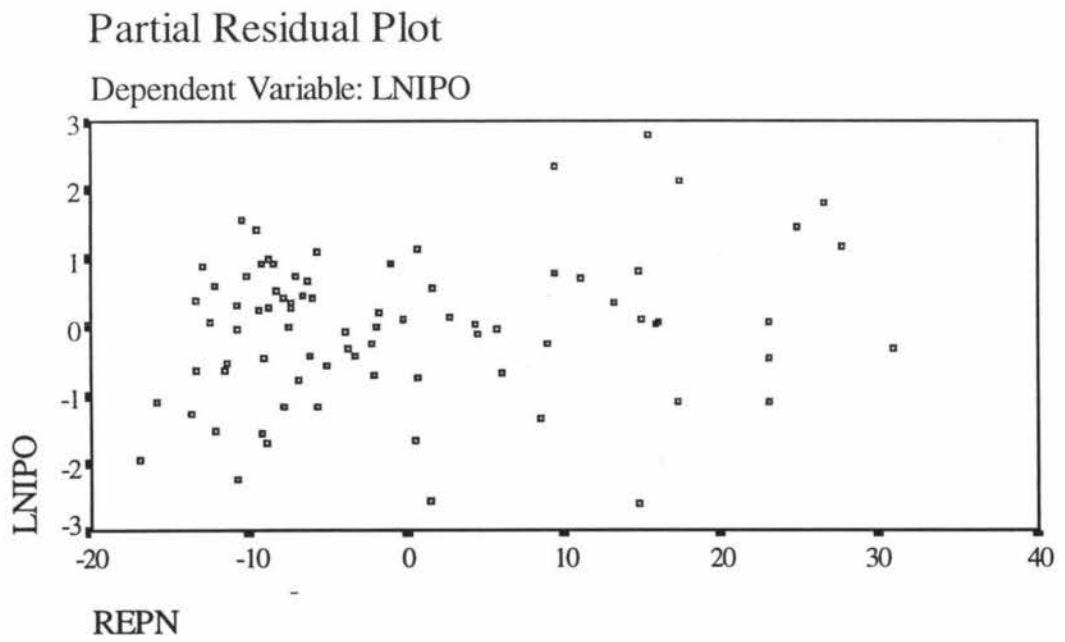


Figure A-3 Partial Residual Plot of Initial Underpricing and Number of Days Taken to List

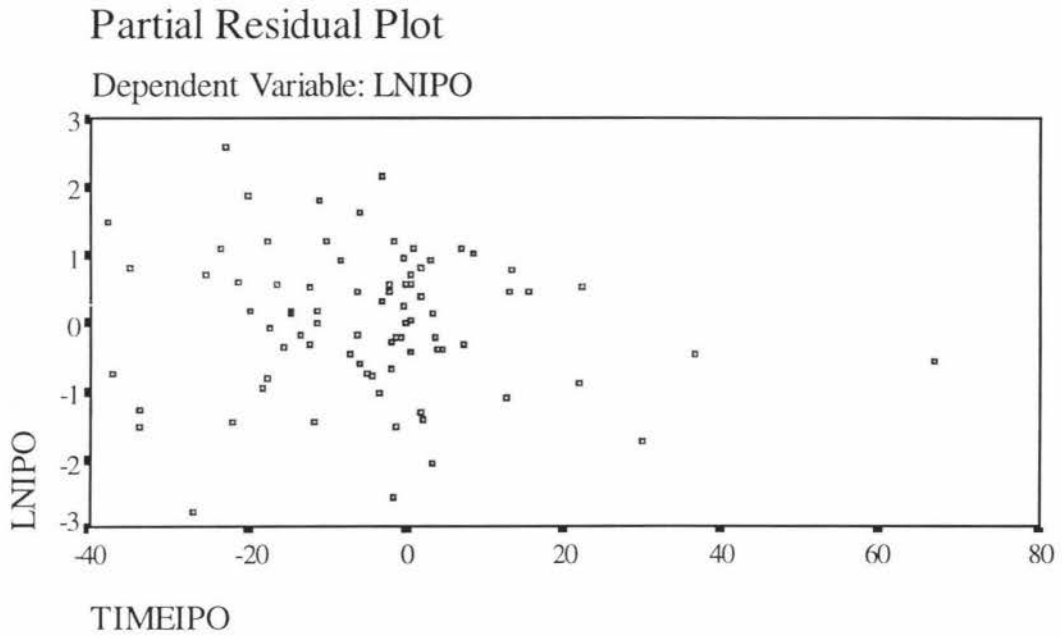


Figure A-4 Partial Residual Plot of Initial Underpricing and Whether the Issuing Firm is New or Existing

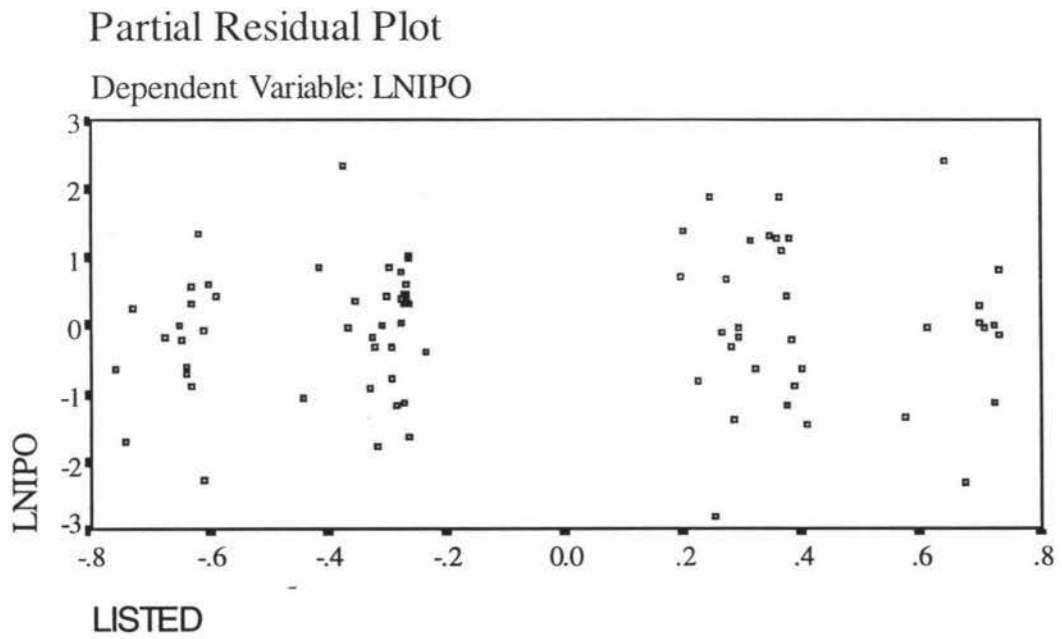


Figure A-5 Regression Plot

Normal P-P Plot Regression Standardised Residual

