The Pricing And Performance Of Convertible Preferred Stock Offerings Following Issuance

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THE PRICING AND PERFORMANCE OF CONVERTIBLE PREFERRED STOCK OFFERINGS FOLLOWING ISSUANCE

by

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ABSTRACT

This dissertation is a comprehensive study of convertible-preferred-stock pricing and performance following issuance. It is the first major academic study that identifies significant abnormal performance of corporate contingent claims following issuance.

The research utilizes both option-based contingent claims valuation models and econometric techniques to investigate the sources of superior investment performance of convertible securities as an asset class that has persisted for the past thirty years.

Two main issues are examined: potential underpricing of convertible preferred stocks at issuance and their subsequent investment performance.

Underpricing is examined based on a robust contingent-claims valuation model. Using two samples of convertible preferred stock offerings (24 issues, 12,051 observations and 69 issues, 28,831 observations respectively), the study provides evidence of statistically and economically significant underpricing at issuance that ranges from 2.9% to 1.4% and persists from the first day of convertible trading up to six months following issuance.

Underpricing is invariant to convertible ratings and the exchange where the issues are traded. It is found, however, that, large and mid cap issues are more likely to be underpriced than small cap convertibles. Also, the offerings that are underwritten by non-reputable investment bankers are more likely to be underpriced than those underwritten by reputable investment bankers.

Abnormal performance based on econometric techniques affirms underpricing at issuance. Statistically significant holding-period excess returns of convertibles over their underlying common stock returns range from 0.81% for the first week to 2.04% for the first five months following issuance. Excess returns are invariant to security ratings, exchange listing, firm size, underwriter reputation and the size of the issue. Further, panel data analysis of daily returns suggests excess returns of 1.1 percent (1.8 percent) for the first week (month) following issuance. Excess returns can be explained by increased sensitivity of convertible returns to the returns of their underlying common stocks in the first six months following issuance. Cross-sectional variations of this increased sensitivity indicates investment-grade issues, listed on NYSE/AMEX, by large firms, using reputable underwriters and for large issues are more sensitive to the underlying common stock in the first six month following issuance than securities with opposing characteristics. Underpricing at issuance is also indicated by investment models favored by convertible trading desks: about one dollar on an average price of thirty five during the first week following issuance with underpricing persisting up to 6 months following issuance. The excess returns cannot be attributed to liquidity, high betas of underlying stock or excess volatility of convertibles following issuance. Conversely, volatility analysis indicates risk-adjusted excess returns are likely to be higher than reported.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AMEX – American Stock Exchange

IPO – Initial Public Offering

NASDAQ – National Association of Security Dealers Automated Quotations

NAV – Net Asset Value

NYSE – New York Stock Exchange

OTC – Over-the-Counter market

REIT – Real Estate Investment Trust

CHAPTER ONE: INTRODUCTION

Convertible securities as an asset class offers returns comparable to equity indexes at less risk. For example, Lummer and Riepe (1993) in their study of convertible bond indexes from 1957-1992 and subsequent updates up to 2000 by Goldman Sachs and Ibbotson Associates show convertibles achieve annual returns of 11.89%, marginally below the S&P 500 index over the same period of 12.97%, with significantly less risk: standard deviation of 12.68% versus 17.03% (Goldman Sachs, 2001).

Market professionals explain the result within the context of portfolio theory: that convertibles cause a favorable shift in the efficient frontier (Calamos, 1998). Such explanations contradict the efficient market hypothesis, as a derivative can be represented as a portfolio of the underlying equity and the riskless asset. Accordingly, the academic literature is largely silent. Lummer and Riepe (1993) and Goldman Sachs (2001) identify three potential drivers of abnormal performance: underpricing at issuance, non-optimal call policies by firms that issue convertibles, and the "higher betas" hypothesis.

Firms seldom call their convertibles according to the optimal theoretical call policy (see Ingersoll, 1977b; and Mikkelson, 1981 and 1985). However, Byrd, Mann, Moore, and Ramanlal (1998) show for convertible preferreds and Affleck-Graves and Miller (2003) for convertible debt that firms act rationally while timing calls of convertibles so as not to leave value on the table for convertible securities. The "higher betas" hypothesis states that the abnormally high returns of convertibles over the past thirty years is a consequence of the fact that the common stock of the typical firm issuing convertible securities has a significantly higher beta than the S&P 500 portfolio. As such, the apparent superior long-term performance of convertible indexes is driven in large part by the corresponding performances of the underlying high-risk common stocks.

Underpricing of financial securities at issuance has produced a voluminous literature; however, the effort is concentrated largely on the underpricing of common stock IPOs. For fixed-income securities the literature is less extensive, and only three studies that we are aware of address underpricing of convertibles: Loderer, Sheehan and Kadlec (1991) for convertible preferreds and Kang and Lee (1996) for convertible bonds; Goldman Sachs (2001) reiterate their long-standing belief and advice to clients that underpricing at issuance and the unwinding of this undervaluation will continue to be a key driver for sustained long-term superior performance of convertibles.

Unfortunately, findings by Loderer, Sheehan and Kadlec and Kang and Lee are diametrically at odds with investment advice by Goldman Sachs relating to underpricing of convertibles at issuance leaving the superior performance of convertibles largely unexplained. Kang and Lee find that while convertible debt offers 1.11% excess returns at issuance, long-term performance over 125 and 250 days are not significantly different from their seasoned counterparts. Loderer, Sheehan and Kadlec find that convertible preferreds offer no excess returns either at issuance or for holding periods up to 30 days.

Relatedly, Amman, Kind and Wilde (2003) find that convertible bonds on the French market are underpriced about 3% using a binomial-tree model with exogenous credit risk; they test for general underpricing and not underpricing at issuance. In contrast, Ramanlal, Mann and Moore (1998) find no evidence of general underpricing of convertible preferred stock using an option-based valuation model.

One potential explanation why prior empirical studies fail to uncover underpricing at issuance is that the relation between convertibles and their underlying equity is highly nonlinear. As such, linear regression-based empirical studies using a convertible index as the bench mark performance are unsuitable and lack the statistical power to identify underpricing. On the other hand, option-based valuation models that incorporate realistic contract provisions are better suited to serve as bench marks against which to assess mispricing.

In this study, I examine underpricing of convertibles at issuance using the contingent-claims valuation model tested by Ramanlal, Mann, and Moore (1998). Based on their large scale testing, the model produced mean pricing errors of about –0.18%. To increase the robustness of results, I examine two samples of convertible preferred stocks for a period of two years following issuance: the original sample of 24 convertible preferred stocks (sample one; 12,051 daily observations; issued from 1967 to 1986) used by Ramanlal, Mann, and Moore in their tests of alternative valuation models and a new sample of 69 convertible preferred stocks (sample two; 28,831 daily observations; issued from 1992 to 2002) collected specifically for this study.

Assuming the contingent-claims model provides true measures of fundamental value, I calculate pricing errors, (market price – model price)/model price, and examine how these errors vary with time following issuance. On average, issues are underpriced 1.78% (1.39%) for the first six months following issuance relative to the remaining 18 months in sample one (sample two). Panel data analysis reveals that underpricing varies approximately from 2.9% to 1.4%

(1.84% to 1.22%) for sample one (sample two) and decreases with time over the six-month period following issuance. The underpricing is statistically and economically significant.

Cross-sectional analysis of underpricing yields several interesting results. First, I find that mid and large cap issues are significantly underpriced with virtually no underpricing of small cap issues. Second, NYSE/AMEX listed issues are more largely underpriced than issues listed on NASDAQ/OTC. Third, there is indication that investment grade issues are more largely underpriced than non-investment grade issues. There are all counterintuitive results.

In contrast, there are other intuitive findings. While reputable underwriter issues are underpriced for six months following issuance, non-reputable underwriter issues are underpriced even more. There is also indication that while mid/large size issues are underpriced for the first six month following issuance, small size issues are underpriced even more for the first four months. These cross-sectional results are interesting since Kang and Lee (1996) find virtually no cross-sectional variation in their study.

In the second part of the study, I look for excess returns in holding periods up to one year as well as for excess daily, monthly and weekly returns in the six months following issuance. I also examine for underpricing using the historical price track model favored by convertible trading desks (Calamos, 1998). All three methods suggest excess returns and/or underpricing up to 6 months following issuance. Holding-period excess returns of convertibles over their underlying common-stock returns range from 0.81% in the first week to 2.04% for the first three-five months following issuance. Panel data analysis of daily returns suggests convertibles offer excess returns of 1.1 percent (1.8 percent) for the first week (month) following issuance. Underpricing at issuance is also indicated by the historical price track model: about one dollar on an average price of thirty five during the first week following issuance with underpricing persisting up to six months following issuance.

Excess returns can be explained by increased sensitivity of convertible returns to the returns of their underlying common stocks. Regardless of their characteristics (investment rating, exchange listing, firm size, underwriter reputation, and issue size), convertibles display increased sensitivity to the underlying common in the six months following issuance. Cross-sectional variations of this increased sensitivity indicate investment-grade issues, listed on NYSE/AMEX, by large firms, using reputable underwriters and for large issues are more sensitive to the underlying common stock in the first six month following issuance than securities with opposing characteristics.

Excess returns cannot be attributed to excess volatility of the convertible because the relative volatility of the convertible to common is actually lower in the 6 months following issuance compared to the remaining estimation period up to two years. Conversely, the volatility analysis indicates risk-adjusted excess returns are likely to be higher than reported. Liquidity is unlikely to explain the excess returns since the relative bid-ask spread of convertibles in less than that of the underlying common in our sample. Further, excess returns are invariant to security ratings, exchange listing, firm size, underwriter reputation and the size of the issue. I also address the “higher betas” hypothesis by measuring holding-period excess returns of convertibles relative to their underlying common stock: superior performance holds notwithstanding higher betas.

My empirical analysis differs from that of Loderer, Sheehan and Kadlec (1991) and Kang and Lee (1996) because I use the underlying common stock returns as the benchmark to measure excess returns as opposed to market indexes. I do not focus my analysis on abnormal returns during the first trading day since abnormal first-day returns do not necessarily lead to long-term superior performance. Instead, I hypothesize that owing to the convertible's complexity, prices take longer to achieve equilibrium so underpricing can persist for extended periods as suggested in Goldman Sachs (2001). Further, I address biases that result when calculating returns using transaction prices (owing to the bid-ask bounce) by using the mid-spread quotes instead but only when accompanying transactions ensure non-stale prices.

CHAPTER TWO: LITERATURE REVIEW

Convertibles as a Unique Asset Class

Convertible bonds and convertible preferred stocks provide their holders with the option to exchange a convertible for a predetermined number of common shares at a specified price. Consequently, convertibles are unusual securities in that they have both fixed income and equity characteristics. Their hybrid nature makes convertible appealing to investors because in a single security investors can obtain the downside protection of a bond and the capital gains opportunity of a common stock.

Beginning with Brigham (1966) a convertible is usually modeled as a straight security and a call option on the company's stock. The call option enables investors to benefit from future capital appreciation in the firm's equity, while the fixed income component provides the downside protection. Also, the opportunity to convert the fixed-income security into shares of common stock may protect convertible holders from reduction in investment values due to dramatic increases in interest rates.

Historically, investors have overlooked convertible securities probably due to their complexity and the modest attention given by the financial press (Calamos, 1998). However in recent times convertibles have enjoyed explosive growth. Despite difficult conditions in the U.S.

financial markets in 2000 U.S. convertible issuance reached $61.3 billion, which indicates a 50 percent increase from the record in 1999 (Goldman Sachs, 2001).

It has been often emphasized that convertible bonds are conceptually similar to a package of straight debt plus warrants (Lummer and Riepe, 1993). However, Long and Sefcik (1990) outline several reasons why bond-warrant packages do not eliminate the usefulness of convertibles. First, it is difficult to match the maturities of straight debt and warrants. Straight debt has slightly shorter maturity on average than convertible bonds, but the warrants have much shorter maturities - less than half of their related debt and one third of an average convertible bond. Second, most convertibles contain a call privilege that allows the issuer to either refund the debt or force conversion when the underlying stock price has risen sufficiently. A callable straight bond, on the other hand, cannot be forced to convert by exercising the attached warrant. Third, warrant-issuing firms are perceived to be riskier than those that issue convertibles. Also, underwriting fees are usually smaller for a convertible issue than for a debt plus warrants package. Fourth, usually debt plus warrants offerings provide relatively lower equity than convertible offerings. These differences suggest that convertibles and debt plus warrants packages are issued not as substitutes of each other and attract different groups of investors. Historically, convertibles have been offered much more frequently than straight debt plus warrants (Lummer and Riepe, 1993).

Reasons for Issuing Convertibles and Investing in Convertibles

Any financial security is designed to satisfy both the issuer and the investor. To assess the objectives underlying the issuance of convertible securities and investing in them, two bodies of literature were reviewed – academic publications and non-academic financial press.

There is a number of theories in the literature that explain the reasons of issuing convertibles: reduction in agency costs, reduction in taxes, reduction in transaction costs, regulatory restrictions, signaling theory, equity drawing, etc. Two main schools of thoughts are arguing what convertibles are – an alternative to straight debt or an alternative to ordinary equity. It seems to be a recent trend seeing the convertibles more as a less expensive alternative to straight debt than as a delayed equity financing. However, Brennan and Schwartz (1988) point out that the common misconception is that convertibles are inexpensive source of capital because they carry coupon rates below the market rates of straight debt and allow companies to sell stock at a premium over the current market price. Brennan and Schwartz argue that the cost of convertible debt should be estimated as a weighted average of the explicit interest charges and the implicit opportunity costs associated with the conversion or equity option.

The important feature of convertibles is the relative insensitivity of their value to the risk of the issuing company (Brennan and Schwartz, 1988). Thus, it could be argued that riskier firms would be more inclined to sell convertible debt (Kuhlman and Radcliffe, 1992). Also, convertible bond financing is attractive for firms that have growth potential but find both straight debt and equity financing costly (Jen, Choi, and Lee, 1997). From investors' perspective, there is an evidence of negative (on average) market response to the announcement of new convertible offerings (Jen, Choi, and Lee, 1997).

Non-academic press confirms the trend in perception of convertibles as less expensive alternative to straight debt rather than delayed equity financing. It highlights a number of issues with convertibles: convertibles bring firms greater financial flexibility by tapping a fresh set of investors and by keeping in reserve companies' ability to turn to traditional debt markets later on; investors like the downsized protection that convertibles offer; the biggest drivers of demand for convertibles are international hedge funds; recently private placement of convertibles has developed into a big market; the convertibles are attractive means of financing for companies with stretched balance sheets; convertibles offer borrowers the opportunity of raising considerable sums in a very short time; convertibles are decreasing dilution relative to a straight equity offering and enable access to a diversified investor base; vast majority of convertible issuance is conducted via an accelerated bookbuilding process with transaction launched and completed within one day; "death-spiral" convertibles are convertibles that can be converted into a fixed dollar amount of common stock – shareholders usually face severe dilution with them; pairing convertibles with IPOs allows issuers to raise larger amounts of funding while protecting demand for the common equity portion; hedge funds often short the issuers stock at the same time they buy the convertibles (which suggests that hedge fund managers perceive convertibles as undervalued securities).

Both bodies of the literature suggest that convertibles are complex securities that are appreciated by sophisticated investors but yet to be discovered by general investment public.

Risk and Return of Convertibles

Lummer and Riepe (1993) of Ibbotson Associates seminal study and following updates published by Goldman Sachs show that convertibles achieve returns competitive with stocks' returns, but with lower volatility. Since the early 1970s the total return performance of the U.S. convertible market has been very close to that of the S&P 500 with significantly lower risk. As presented in Table 1, the compound annual return for convertible bonds (11.89%) was marginally below the S&P 500 return (12.97%) from January 1973 to December 2000, with a significantly lower standard deviation of 12.68 percent for convertibles versus 17.03 percent for the S&P 500 (Goldman Sachs, 2001). Over the same period, convertibles have exhibited much better total return than that of long-term investment grade bonds (8.99%), but with only a slightly higher standard deviation (Goldman Sachs, 2001).

Table 1. Returns and Standard Deviations for Various Asset Classes, 1973 – 2000.

Asset Class	*Compound Annual Return*	*Standard Deviation*
Convertible Bonds	11.89%	12.68%
S&P 500	12.97%	17.03%
Long-Term Corporate Bonds	8.99%	11.90%

Source – Ibbotson Associates.

Lummer and Riepe also break the performance numbers into shorter periods for a more comprehensive examination. As presented in Table 2, there are large deviations from expected long-term return within shorter periods. Convertibles often exhibit better returns than that of S&P 500. For instance, in the period 1973-1977, S&P 500 posted a negative return, while convertibles had a positive return of 6.79 percent. Also, the total returns of convertibles within the most recent period presented here (1998-2000) is significantly above the historical data, though with much higher standard deviation. Goldman Sachs (2001) examines annual returns of S&P 500 and convertibles from 1973 to 2000 and reports that convertibles and common stocks typically move together. However, convertibles' fluctuations tend to be lower than that of common stocks.

Table 2. Risk and Returns over Five-year Increments, 1973 – 2000.

Asset Class		*1973 1977*	*1978 1982*	*1983 1987*	*1988 1992*	*1993 1997*	*1998 2000*
Convertible Bonds	Compound Annual Return	6.79%	16.48%	11.45%	12.49%	12.01%	12.62%
	Standard Deviation	10.79%	13.86%	14.18%	8.86%	8.34%	21.90%
S&P 500	Compound Annual Return	-0.21%	14.05%	16.49%	15.89%	20.24%	12.26%
	Standard Deviation	17.62%	18.44%	21.08%	15.48%	12.74%	20.06%
Long-Term Corporate Bonds	Compound Annual Return	6.29%	5.57%	14.06%	12.50%	9.08%	4.98%
	Standard Deviation	8.72%	15.99%	11.36%	7.01%	7.67%	5.95%

Source – Ibbotson Associates.

Lummer and Riepe and subsequent updates by Goldman Sachs and Ibbotson Associates provide statistics for convertible bonds and stocks in months when the S&P 500 rose and fell. As presented in Table 3, it seems that convertibles participated in 70 percent of upward equity market movements and in only 52 percent of the downside movements (Goldman Sachs, 2001).

Table 3. Summary Statistics of Monthly Returns in Up and Down Equity Markets, 1973 – 2000.

	In Months When The S&P 500			
	Increases		*Decreases*	
	S&P 500	*Convertibles*	*S&P 500*	*Convertibles*
Arithmetic Mean Return	3.81%	2.65%	-3.09%	-1.60%
Standard Deviation	2.90%	2.33%	3.08%	2.93%
Number of Months	205	205	131	131

Source – Ibbotson Associates.

Sighted above studies provide overwhelming evidence of the long-run overperformance of convertible securities as an asset class. Over the long run convertibles are expected to have return and risk between that of stocks and straight corporate bonds. However, over the last thirty years convertibles have had returns almost as high as stocks' returns with substantially less risk.

Potential Explanations of Superior Performance

There is no conclusive explanation of such a great investment performance of convertible securities in the literature. However, Lummer and Riepe (1993) and following Goldman Sachs studies identify three potential drivers for overperformance: underpricing at issuance, non-optimal call policies of companies that issue convertibles and "higher betas" explanation.

Using conventional bond plus warrant valuation models, convertibles seem to be underpriced at issuance (Goldman Sachs, 2001). This undervaluation, if confirmed, may be a source of strong investment performance. Lummer and Riepe argue that underpricing should probably be expected due to the fact that a convertible issuance often causes a short-term dip in the share price. Also, underpricing can be a cost of entry to the market, given the large size of many convertible offerings. In addition, there is an argument that initial valuations of convertibles that may appear low from the investor point of view, can be still attractive from the issuer perspective given the tax deductibility of the coupon payments on a convertible bond. However, this argument does not hold for convertible preferred stocks, since their dividend payments are not tax deductible.

Companies seldom call their convertibles at the optimum point as suggested by the theoretical models (Ingersoll, 1977b; Mikkelson, 1981 and 1985; and others). Created by non-optimal call policies inefficiency may allow for additional performance of convertibles versus theoretical expectations. The "higher betas" explanation has the following reasoning. The abnormally high return of U.S. convertibles over the last thirty years can be a consequence of the fact that a typical issuer of convertibles has a significantly higher beta underlying stock than

S&P 500. In a period of long-run excess returns from equities such companies' stocks and, consequently, convertibles would provide higher returns to investors.

Related Underpricing Issues

The securities underpricing literature can be divided into three distinguished parts: equity IPO underpricing, fixed income securities underpricing and the underpricing of convertibles. The equity IPO literature is the most extensive one.

Equity IPO Underpricing

Despite the presumed intention of underwriters to obtain the best price for the issuing firm by balancing supply and demand, the voluminous equity IPO literature suggest that they are not able to accomplish this task consistently. For instance, Krigman, Shaw and Womack (1999) report that in their sample of 1,232 large-capitalization IPOs in the period from 1988 to 1995, 12% of stocks provided a first-day return of 30 percent or more.

Most of the theories of equity underpricing imply that it is undertaken deliberately by investment bankers. Supporting research provides different views on the reasons of intentional underpricing. Among the most popular explanations are asymmetric information, signaling theory, equilibrium pricing and underwriters' reputation capital, setup costs and relationship specific issues in pricing securities, investment bankers' reputation and compensation, underwriter price support hypothesis, bookbuilding theories, and the litigation-risk hypothesis.

Smith (1986) addresses the new securities offerings through associated stock market reactions. He analyses incentives for underpricing of new issues and various contractual alternatives employed in security issues, such us right or underwritten offers, negotiated or competitive bid, best efforts or firm commitment contracts, and shelf or traditional registration. The author surveys the explanations of the underpricing in the literature before 1986 and distinguishes two main hypotheses that have been offered to explain IPOs underpricing: the asymmetry in information between the issuing firm and the investment banker, and between informed and uninformed potential security holders. Smith's survey suggests that the degree of underpricing exceeds 15 percent.

Beatty and Ritter (1986) blend the underpricing and investment banking reputation issues. They demonstrate that there is a monotone relation between the expected underpricing of an IPO and the uncertainty of investors regarding its value. The authors are arguing that the resulting underpricing equilibrium is enforced by investment bankers, who have reputation capital at stake. The equilibrium exists to satisfy both potential investors and the issuers. An investment banker that fails to achieve this underpricing equilibrium will lose either the investors, if it does not underprice enough, or the issuer, if it underprices too much, and therefore sacrifice the value of its reputation capital. Carter, Dark, and Singh (1998) find that IPOs managed by more reputable underwriters are associated with less short-run underpricing and their underperformance over a three-year period is less severe.

Peavy (1990), investigates closed-end fund IPOs. In contrast to other equity IPOs, closed-end funds IPOs do not show significant positive initial return. Instead, new shares on average are overpriced. The results are consistent with IPO models that predict no significant underpricing for new issues that have little asymmetry of information about their initial values. Closed-end fund IPOs have less asymmetric information about the value of the shares being offered, because the underlying asset is a portfolio and the composition of the initial portfolio and NAV (net asset value per share) are reported in the prospectus.

James (1992) addresses the optimality of IPO pricing. He investigates the effect of relationship specific assets or "setup costs" on the pricing of investment banking services. These relationship specific assets create switching costs for subsequent security offerings. Therefore, firms that expect to make subsequent equity offerings should receive engagement discounts in the form of lower underwriter spreads. The empirical investigation finds significantly lower spreads for firms that make subsequent issues and that a firm's likelihood of changing underwriters in a subsequent offer is related to the time between offerings and the underwriter's pricing performance. The results indicate that the deviation from optimal IPO pricing carries a penalty for the underwriter.

Boehmer and Fishe (2003) examine if regular investors (those who receive repeat allocations from the same underwriter in many different IPOs) help to reduce underpricing in IPOs as implied by existing bookbuilding theories. Using a number of different measures Boehmer and Fishe find no evidence that underpricing is reduced in IPOs that use more regular investors. Several other studies examine IPO allocations, pre-market information production and underpricing (Ljungqvist and Wilhelm, 2002; Aggarwal and Conroy, 2000; Aggarwal, Prabhala and Puri, 2002; Aggarwal, 2003). They conclude that discretionary allocations promote price discovery and reduce indirect insurance costs for IPO firms; institutions do more flipping than retail investors; institutional allocation has positive relation with day one IPO returns; there is also a strong positive relationship between initial returns and the time of the day when trading starts.

Aggarwal, Krigman, and Womack (2002) develop a model in which managers strategically underprice IPOs to maximize personal wealth from selling shares at lockup expiration. The reasoning here is that the first day underpricing generates information momentum by attracting attention to the stock and shifting the demand curve for the stock outward. Sherman and Titman (2002) combine the information generated during the book-building method of marketing IPOs and potential underpricing. They conclude that when there is little need for accurate pricing, the expected gain from underpricing exactly offsets the investors' costs of acquiring information. However, when pricing accuracy is important, the number of investors participating in the IPO is larger and underpricing is greater.

Krigman, Shaw and Womack (1999) examine the relationship between opening-day return and following stock performance and show that initial returns predict subsequent one-year excess returns. Hot IPOs outperform in the first year, cold IPOs underperform, and extra-hot IPOs (those with the first-day return in excess of 60 percent) provide the worst future performance. These results contradict Ritter (1991) and Carter and Dark (1993) and support Levis (1993) findings.

Michaely and Shaw (1994) test the empirical implications of several models of IPO underpricing. They show that in markets where investors know a priory that they do not have to compete with informed investors, IPOs are not underpriced. Also, IPOs underwritten by reputable investment banks experience significantly less underpricing and perform significantly better in the long run. The authors do not find empirical support for the signaling models that try to explain why firms underprice. They also conclude that firms that underprice more return to the reissue market less frequently and for lesser amounts than firms that underprice less. In addition, firms that underprice less experience bigger earnings and pay higher dividends, contrary to the models' predictions.

Ng and Smith (1996) investigate issuers' decisions to include warrants as compensation to underwriters. They examine a sample of 1, 991 negotiated firm commitment issues of seasoned equity. The authors find direct evidence that a warrant compensation functions as a bond, substituting for reputational capital and enabling the underwriter to certify the issue price. To a smaller degree, the decision also is affected by regulations on underwriter compensation and on the use of underwriter warrants. Issuers' decisions are consistent with an objective of minimizing total underwriting cost, including cash compensations, warrants, and underpricing.

Ruud (1993) provides a unique assessment of the underpricing issue. Her investigation of the distribution of initial returns following IPOs indicates that positive mean initial returns may reflect the existence of a partially unobserved negative tail. Instead of forming a symmetric curve centered over a positive mean, the distribution of one-day return peaks steeply around zero and includes very few observations in the negative tail. The findings suggest that the apparent underpricing, reflected in high average initial returns, might be largely attributed to the frequent market practice of underwriter price support or stabilization. In presence of active price support in the aftermarket, observations that would have occurred in the negative tail of the distribution (indicating negative returns) may be moved to a zero or slightly negative return by a standing purchase order at or slightly below the offer price. When the artificial suppression of the left tail of the distribution at zero is taken into account through Tobit analysis, the adjusted mean one-day return is close to zero and the underlying distribution of returns is nearly symmetric, which is consistent with the behavior of ordinary daily returns. Asquith, Jones, and Kieschnick (1998) provide further support to price stabilization hypothesis and suggest that the cross-sectional distribution of one-day returns of IPOs is modeled better as a mixture of two distributions: one distribution being consistent with underpricing and the other with price stabilization. Chowdhry and Nanda (1996) argue that price stabilization compensates uninformed investors ex post for the adverse selection cost they face in bidding for IPOs. However, Aggarwal (2000) finds that aftermarket activities are less transparent and include stimulating demand through short covering and restricting supply by penalizing the flipping of shares. Underwriters' price support activities include aftermarket short covering, penalty bids, and the selective use of the overallotment options.

Dandapani et al. (1992) and Reside et al. (1994) explore a tax-based motive for the underpricing of IPOs. They show that in the presence of taxes and for certain level of ownership retained by an entrepreneur, he/she may have an incentive to underprice the issue. Their model implies that personal tax rate on ordinary income and capital gains may, in part, determine IPO pricing. The model predicts that an increase in the capital gains tax rate should lower the degree of underpricing. Hensler (1995) and Lowry and Shu (2002) provide support for litigation-risk hypothesis, which implies that firms with higher litigation risk underprice IPOs by a greater amount as a form of insurance. They suggest that underpricing reduces expected litigation costs.

Lowry and Schwert (2002) find that IPO volume and average initial returns are highly autocorrelated. Rajan and Servaes (1997) report that higher underpricing leads to increased analyst following. In turn, more firms complete IPOs when analysts are particularly optimistic about the growth prospects of recent IPOs. In the long run, however, IPOs have better stock performance when analysts ascribe low growth potential rather than high growth potential. Rajan and Servaes suggest that the IPO anomalies may be partially driven by over-optimism.

Welch (1989) presents a signaling model, which implies that high-quality firms underprice IPOs in order to obtain a higher price for seasoned offerings. Low-quality firms must invest in imitation expenses to appear to be high-quality firms, but with some probability this imitation is discovered between offerings. Smart and Zutter (2003) demonstrate a link between underpricing and corporate control. They find that dual-class IPOs experience less underpricing than single-class IPOs. In dual-class IPOs insiders issue ordinary common stock to the public while retaining ownership of a class of shares with superior voting rights. Busaba, Benveniste, and Guo (2001) incorporate into the analysis the option of issuers to withdraw IPOs during a process of bookbuilding. They find that the option to withdraw reduces underpricing by strengthening the issuers' bargaining power with respect to investors and underpricing is lower when investors' perception of an IPO's likelihood of withdrawal is higher.

The underpricing of IPOs that has been widely documented appears to be a short-term phenomenon. Ritter (1991) reports that, on average, IPOs substantially underperform from the closing price on the first day of public trading to their three-year anniversaries. Schultz (2003), Gompers and Lerner (2003) and numerous other studies also provide the evidence of the long-run underperformance following equity offerings. Jain and Kini (1994) find a significant decline in operating performance of firms as they make transition from private to public ownership. Also, Ritter and Welch (2002) review the theory and evidence on IPO activity and conclude that many IPO phenomena are not stationary. They suggest that research on IPO allocation is the most promising area at the moment and asymmetric information is not the primary driver of many IPO phenomena. Ritter and Welch argue that future progress in the literature will come from non-rational and agency conflict explanations.

Since convertibles are hybrids of fixed income and equity securities, I believe that extensive equity underpricing literature with its well developed theories can provide useful insights on underpricing of convertible offerings. More "equity like" convertible issues are expected to behave and be underpriced in some degree as equity IPOs.

Fixed Income Security Underpricing

For fixed income securities the literature is not as extensive as for equity IPOs. In contrast with numerous studies that find significant underpricing for equity IPOs, Wang and Gau (1992) document a statistically significant negative average return in the first trading day for a sample of 87 IPOs of real estate investment trusts (REIT). The overpricing results are invariant to offer price, issue size, distribution method, offer period, and underwriter reputation. Newly issued REITs, on average, substantially underperform a matching sample of seasoned REITs during the first 190 trading days. Interestingly enough, buyers of overpriced REITs are predominantly individual (non-institutional) investors.

Wasserfallen and Wydler (1988) examine underpricing of new bond issues in Swiss capital markets. They find a small underpricing that is comparable with the difference in transaction costs between new versus seasoned offering markets. They report that two days after issuance, there is no remaining evidence of underpricing. Datta, Iskandar-Datta, and Patel (1997) examine the initial-day and aftermarket price performance of corporate straight debt IPOs. They find that speculative grade IPOs are underpriced (similar to equity IPOs), while investment grade IPOs are overpriced. IPOs of investment grade debt are typically issued by firms listed in the major exchanges and underwritten by prestigious underwriters. Junk bond IPOs are more likely to be handled by less prestigious underwriters and are typically issued by OTC firms. Also, the analysis reveals that bond rating, market listing of the firm, and investment banker quality are significant determinants of bond IPO returns.

Loderer, Sheehan, and Kadlec (1991) examine 1,600 seasoned equity offerings and 250 issues of new classes of preferred stock. They conclude that preferred stock issues are not underpriced. Also, the analysis reveals little evidence that underwriters systematically set offer prices below the market price on the major exchanges, though they may do so for NASDAQ issues.

Overall, fixed income securities pricing literature argue that these securities' IPOs are not underpriced, with the exception of junk bond IPOs.

Underpricing of Convertibles

For convertibles the literature is even less extensive. There are three major studies addressing the underpricing of convertibles: Loderer, Sheehan and Kadlec (1991) for convertible preferreds and Kang and Lee (1996) for convertible bonds; Goldman Sachs (2001) reiterate their long-standing belief and advice to clients that underpricing at issuance and the unwinding of this undervaluation will continue to be a key driver for sustained long-term superior performance of convertibles.

Unfortunately, findings by Loderer, Sheehan and Kadlec and Kang and Lee are diametrically at odds with investment advice by Goldman Sachs relating to underpricing of convertibles at issuance leaving the superior performance of convertibles largely unexplained.

Loderer, Sheehan and Kadlec (1991) examine convertible preferred stocks at issuance and find no evidence of underpricing. Underpricing in their study is measured by a significant positive return from the offer price (the price of the initial public offering to private investors) to the first closing price on an exchange (the first price that results from trading by all investors on an open exchange). They also examine excess returns for holding periods up to 30 days.

Kang and Lee (1996) study convertible debt offerings using a sample of 91 issues from 1988 to 1992. They find a mean initial excess return at issuance of 1.11%, with almost 70% of excess returns positive. Excess returns are calculated relative to the Merrill Lynch Convertible Bond Index for investment-grade and speculative-grade bonds and are invariant to the coupon size, maturity, issue size or bond rating. They also, examine long-term convertible performance over 125 and 250 days and conclude that they are not significantly different from their seasoned counterparts.

Relatedly, Amman, Kind and Wilde (2003) find that convertible bonds on the French market are underpriced about 3% using a binomial-tree model with exogenous credit risk; they test for general underpricing and not underpricing at issuance. In contrast, Ramanlal, Mann and Moore (1998) find no evidence of general underpricing of convertible preferred stock using an option-based valuation model.

Convertible Call Policies

The finance literature has given considerable attention to the optimal call policy of convertible securities. The issue was first raised by Ingersoll (1977a). Assuming the irrelevance of the capital structure (if the Modigliani-Miller Proposition I holds) to the valuation of the claims against the firm's assets Ingersoll defines the optimal call policy as a policy, which minimizes the market value of the convertible. With the assumptions of perfect capital markets and no call notice, the optimal policy suggests calling as soon as the conversion value increases to equal its effective call price. The call eliminates the convertible's conversion option and its value is transferred to current common stock holders.

The empirical evidence suggests, however, that this perfect market call policy in not the one that companies actually follow. Ingersoll (1977b) documents that convertible bonds are called late. The conversion value exceeds the call price by 60%-80% at the call announcement.

Mikkelson's results (1981, 1985) support the evidence documented by Ingersoll. This apparent puzzle triggers both theoretical and empirical research.

Ingersoll (1977b) suggests a potential explanation of the gap between theory and practice by a managerial incentive to delay calling until the conversion value exceeds the call price by a considerable amount to avoid redemption costs. He also indicates that these costs are not high enough to explain the observed call policies. Asquith (1995) attempts to justify the conversions delays by the contractual call-protection periods. However, the violations of the perfect market's call policy are widely observed beyond the call-protection periods. Jaffee and Shleifer (1990) and Asquith (1995) advocate the financial distress theory to explain the delayed conversion. If the conversion value were to fall below the call price during the call-notice period, the cash outflow to redeem may expose the firm to financial distress. Hence, firms should delay calling until the conversion value is comfortably above the call price to have a margin of safety. However, Byrd, Mann, Moore and Ramanlal (1998) study provides the evidence against this explanation. Harris and Raviv (1985) develop a signaling theory about the delayed call policies. According to them a call signals negative information about the firm's future performance. There is no consistent evidence for or against this theory, but it has been documented that the negative effects are short lived (Mazzeo and Moore, 1992). Several other studies explore the role of cash-flow differences between the convertible and the underlying common stock to explain observed call policies. These studies also cannot provide a reliable explanation of the puzzle.

Byrd, Mann, Moore, and Ramanlal (1998) re-examine managerial objectives and motives to call. They highlight the fact that convertible security holders own a valuable call option on the firm's common equity. The firm's management has a vehicle to remove this option. If total firm value is not affected by a conversion call, the value of the option reverts to current common shareholders. When conversion can be forced, the wealth transferred to common shareholders is the convertible's market price less the option premium. Accordingly, management should execute a call when the net option premium (option premium minus transaction costs) is positive. If the net option premium exceeds zero for periods longer than it is necessary to perform a call, the optimal call policy would be violated. Byrd, Mann, Moore, and Ramanlal provide empirical evidence that this theory holds. They find no significant violation of the optimal wealth transfer policy. This suggests that conversion-forcing calls are executed in common shareholders' interest. When a positive option premium exists, managers tend to call quickly. However, when the option premium is negative, there is no justifiable reason to call. These findings are consistent with the theoretical base of Ingersoll (1977a) and Brennan and Schwartz (1977). Apparently, the optimal wealth transfer theory provides a reasonable explanation of rationality behind observed call policies of firms that issue convertible preferred stocks.

Affleck-Graves and Miller (2003) examine a sample of 713 calls of convertible debt. They find evidence of marginal positive long-run returns that provides support for the model that calls of convertible debt signal the realization of profitable investment options. Their findings also suggest that firms act rationally when calling convertible bonds.

Valuation Models of Convertibles

Pricing of interest rate derivatives and instruments with embedded options, such as callable convertible bonds and preferred stocks, is typically performed utilizing models of the term structure of interest rates.

There are two main approaches to the modeling of the term structure of interest rates in continuous time. The equilibrium approach starts from a description of the underlying economy and from assumptions about the stochastic evolution of one or more exogenous factors or state variables and about the preferences of an investor. General equilibrium considerations are utilized to exogenously derive the interest rate and the price of all contingent claims. Hence, the initial term structure of interest rates is an output of the model, which can be calibrated so that the generated yield curve closely matches the actual yield curve. No-arbitrage (or arbitrage-free) approach starts from assumptions about the stochastic evolution of one or more interest rates and derives the prices of all contingent claims by involving the condition that there are no arbitrage opportunities in the economy. These models replicate the current yield curve exactly.

Two groups of equilibrium models that can be distinguished are single factor and two-factor models. Rendleman and Bartter (1980) model is a single factor two-parameter model where interest rates follow geometric browning motion, which is assumed to be similar to stock prices movement. Vasicek (1977) model is a single factor three-parameter model, which introduces mean reversion. Cox, Ingersoll and Ross (1985) model is a single factor three-parameter model, which keeps mean reversion and introduces a square root process to eliminate the possibility of negative interest rates. Two-factor models are represented by Brennan and

Schwartz (1982) and Longstaff and Schwartz (1992) models. Brennan and Schwartz introduce a four-parameter model where both short and long rates are stochastic and short rates exhibit mean reverting to long rates. Longstaff and Schwartz introduce stochastic volatility.

The questionable feature of the equilibrium models is that the generated yield curve closely but not exactly matches the actual yield curve. As a result, current bonds are not priced precisely and even a small mispricing of underlying securities results in large errors in pricing of derivatives.

No-arbitrage models match the current yield curve exactly. It allows them to price straight securities exactly resulting in reduced errors in models' prices of derivatives. They can be split into two main categories: models of forward rates and models of short rates. The forward rates group is represented by Heath, Jarrow and Morton (1992). The problem with these models is that the short rate obtained through the modeling of forward rates to replicate the current yield curve does not follow Markov process that eliminates the opportunity of employing the tree methodology to price derivatives. The short rate models do not have such a disadvantage. The first model in this category is Ho and Lee (1986) model. The model is arithmetic Brownian motion where the drift term is time dependent to ensure the exact matching of the current yield curve. There is no mean reversion, both short and forward rates have the same volatility and interest rates can be negative in this model. Hull and White (1990) introduce mean reversion. Black, Derman and Toy (1990) include another time dependent function in the model. In addition to the replication of the current yield curve, it allows to match the volatilities of all spot and forward rates at time zero. Also, they use geometric Brownian process, which removes the problem of negative interest rates. Black and Karasinski (1991) introduce the third time-dependent function which can be fitted to the cap or future local volatility curves. However, Hull and White (1994) criticize this model for the overparameterization (too much fitting). They argue that it leads to a non-stationary volatility structure. Further development is coming with the introduction of the second factor into the models.

Litterman and Scheinkman (1991) argue that at least three factors are needed to fully capture the variability of interest rates. However, as documented in Litterman and Scheinkman and Chapman and Pearson (2001), around 90 percent of the variation in the U.S. Treasury rates can be explained by the first factor corresponding to changes in the general level of interest rates. Consequently, the relationship between the level of interest rates and their expected changes and volatilities will be dominated by the influence of the first factor, which is typically identified with the instantaneous or short rate of interest (Chapman and Pearson, 2001). Even though one-factor models are based on the simplifying assumption that changes in interest rates of all maturities are driven by changes in a single underlying random factor - short interest rate, with careful calibration and accommodation of realistic and complex contractual provisions, they provide satisfactory results.

Ramanlal, Mann, and Moore (1998) test several contingent claims valuation models adapted to callable convertible preferred stocks. This is the first and only one large scale test of these models. They test Ingersoll (1977a, b), Brennan and Schwartz (1977, 1980), Emanuel (1983) and their own extension of Brennan and Schwartz (1977) model. Brennan and Schwartz specify a general algorithm for valuing callable and convertible bonds which is robust to a very general set of contract provisions. Ramanlal, Mann, and Moore modify this algorithm such that the improved model is applicable to callable and convertible preferred stocks. The new model can accommodate a variety of realistic contract provisions including a call and/or conversion profile that varies over the security's life, non-constant common and preferred dividends, etc. Ramanlal, Mann, and Moore utilize five convertible preferred valuation models to calculate model prices for 27,544 observations per model. The analysis of the models' and market prices reveals that their modified model fits the data best. The mean pricing error for the full sample is approximately negative 0.18 percent. Valuation models that do not incorporate the call protection period and time-varying call prices resulted in higher mean pricing error (-0.34 percent for periods when the call protection period is passed and negative 5.45 percent when the issues are not yet callable). The models that ignore callability and both callability and convertibility have 12.57 and negative 36.57 percent mean errors respectively.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

Testing underpricing at issuance as a potential source of abnormal investment performance of convertible securities can be done by two ways: empirical and theoretical. Empirical methods usually make use of the estimation of initial returns of convertible security issues and, then, comparing these returns to some convertible index return to identify the excess return at issuance (Kang and Lee, 1996). Also, cross-sectional regression usually is performed to identify the security characteristics that explain excess returns (Kang and Lee, 1996). This approach is not difficult to implement, but the reliability of the results is questionable. First of all, the benchmark return (Merrill Lynch Convertible Bond Index for example) includes the returns that are subject of the analysis. That makes the benchmark somewhat contaminated. Also, a potential explanation of controversial results of empirical studies on underpricing of convertibles is the highly non-linear relation between the value of a convertible and the factors that influence this value: value of a firm, its volatility, interest rates, common and convertible dividends, call and conversion contractual features, etc. Consequently, linear regression-based empirical studies on underpricing simplify the relation and may produce questionable results.

Another method for testing underpricing at issuance is to compare market prices against model prices. Properly implemented valuation model that incorporates all realistic contract provisions can provide better insights on the underpricing issue. If the model close replicate market prices later in convertible life, but indicate underpricing shortly after issuance, it will provide a reliable evidence of convertible underpricing. The choice of the model is critical in this case, as we have to be confident that the difference in market and model prices is based on the underpricing but not on the model specification flaws. As I am aware of only one large-scale test of convertible valuation models (Ramanlal, Mann, and Moore, 1998), the logical choice is to utilize the model that performed the best in this test - the Ramanlal, Mann, and Moore extension of Brennan and Schwartz's (1977) model. Provided that this model fits the market data with the mean pricing error of (- 0.18) percent, I can test if the error is consistent with the lifespan of a convertible preferred stock.

In addition to general testing for underpricing, the following cross-sectional analyses are conducted to highlight the nature of underpricing:

1. Investment grade convertible preferred stock versus speculative grade and non-rated convertible preferred stocks. Investment grade issues are more "debt-like" and, thus, are expected to be less underpriced then more "equity-like" speculative grade and non-rated issues.
2. Issues that were underwritten by highly reputable investment bankers versus those that were underwritten by less reputable investment bankers. Investment bankers' reputation influences the degree of equity IPO underpricing. Thus, the degree of convertible preferred stock underpricing is expected to be inversely related to the reputation of the investment banker that underwrites the issue.
3. NYSE and AMEX traded versus NASDAQ and OTC traded issues. As proposed by Affleck-Graves et al. (1993) the degree of informational asymmetry and, consequently, the degree of underpricing depends on the trading systems that certify the quality of IPOs through their

initial and continued listing standards. Accordingly, I expect NASDAQ and OTC traded convertible preferred stocks to be more underpriced than NYSE and AMEX listed issues.

4. Large capitalization firm issues versus small capitalization firm issues. Also, large size offerings versus small size offerings. Assuming that large firms and large size offerings are more followed by financial analysts than small firms and small size offerings, the degree of informational asymmetry is less for large firms and large size offerings. Consequently, I expect small capitalization firm convertibles and small size offerings to be more underpriced than their counterparts.

<u>The Valuation Model</u>

Ramanlal, Mann, and Moore (1998) model is an extension of Merton (1974) model, which states that any contingent claim on the firm's value can be written as a function of the firm's value and the time $f(V,t)$, where: f is a contingent claim, V is the firm value, and t is the time.

Merton assumes that the dynamics of the firm's value satisfies the stochastic differential equation:

$$dV = (\alpha V - C)dt + \sigma V d\tilde{z} \tag{1}$$

where: α is instantaneous growth rate of V, C is the continuous cash flow for all claims, σ is the standard deviation of the instantaneous return dV/V and $d\tilde{z}$ is a Weiner-Bachelier variate.

The dynamics of the contingent claim *f* can also be described by a stochastic process similar to the Equation 1:

$$df = (\alpha_f f - c)dt + \sigma_f f d\tilde{z} \qquad (2)$$

where: α_f and σ_f are instantaneous growth rate and the standard deviation of the contingent claim, and *c* is the continuous cash flow rate for the contingent claim.

Merton (1974) utilizes Ito's lemma to express *df* in terms of the first and second derivatives of *f* with respect to *V*, and the first derivative of *f* with respect to *t*. If a hedging portfolio with instantaneous return *dX* is formed, the riskless portfolio can be constructed and the no-arbitrage equilibrium then requires that *dX*=*rdt*, where *r* is the instantaneous risk-free rate:

$$\frac{1}{2}\sigma^2 V^2 f_{vv} + (rV - C)f_v - rf + c + f_t = 0 \qquad (3)$$

where: f_{vv} and f_v are the first and second derivatives of the contingent claim with respect to the firm's value, and f_t is the first derivative of *f* with respect to time.

Equation 3 is a general partial differential equation that all contingent claims on the firm's value should satisfy. Most of the realistic contractual provisions, such as call and conversion options, can be modeled by specifying boundary conditions for Equation 3.

Ingersoll (1977a) provides a closed form solution of Equation 3 for the case when the underlying stock does not pay dividends (i.e., $C = c$), the preferred stock is callable at any time at a constant amount k and is convertible any time for a constant proportion γ of the firm value V. However, Ingersoll's assumptions do not reflect typical contracts, as they do not allow for a call protection period and non-zero dividends of the underlying common stock. The upper boundary condition that arises from the theoretically optimal exercise of the call and conversion option can be noted as $f(k/\gamma)$ and be imposed on the solution as the constraint $f(V) \leq k$ and $f(V) \geq \gamma V$.

For their best performing model Ramanlal, Mann, and Moore (1998) adopt the solution technique of Brennan and Schwartz (1977) in solving Equation 3, subject to boundary conditions that capture call protection periods and time-dependent contractual call prices k that account for accrued dividends. Also, Ramanlal, Mann, and Moore hold common and preferred dividend rates constant. The lower boundary condition arises from limited liability and is set to $f(0,t)=0$. Reflecting the time-varying call price $k(t)$ and conversion ratio $\gamma(t)$, the upper boundary condition is $f_v(\infty,t) = \gamma(t)$ when the preferred is non-callable, and $f(V,t) \leq k(t)$ and $f(V,t) \geq \gamma(t)V$ when it is callable.

To assess the mispricing, the model prices are compared with market prices following the methodology used by Sterk (1982), Ammann, Kind and Wilde (2003) and others who tested option pricing models. An average of the deviation between the theoretical and observed price and the root mean squared error (RMSE) of the relative mispricing for each time period will be calculated. The RMSE indicates the non-central standard deviation of the relative deviations of model prices from market prices. It can be interpreted as a measure for the pricing fit of the model to market prices.

Computational Algorithm

Closely following Ramanlal, Mann, and Moore (1998), the algorithm is constructed utilizing the results of Ingersoll (1977a) and Brennan and Schwartz (1977). For constant, time independent cash flows C and c, constant call price k, conversion ratio γ, and $f_t = 0$, Equation 3 reduces to the ordinary differential equation:

$$\frac{1}{2}\sigma^2 V^2 f_{vv} + (rV - C) f_v - rf + c = 0 \tag{4}$$

For periodic cash flows, time-varying call price $k(\tau)$ and conversion ratio $\gamma(\tau)$ Equation 3 reduces to the partial differential equation:

$$\frac{1}{2}\sigma^2 V^2 g_{vv} + rVg_v - rg - g_\tau = 0 \tag{5}$$

where: τ is the security's time to maturity γ and k (at which the preferred conversion ratio and call price cease to change).

Convertible preferred stocks with time-varying call and conversion features should satisfy both Equation 4 and Equation 5. Assuming that the periodic cash flows are paid continuously and are time-independent, the preferred satisfies Equation 4. The solution of Equation 4 is *f(V)*. Next, after setting the initial condition for Equation 5 *g(V,0) = f(V)*, the solution of Equation 5 gives the value of the preferred.

For mandatory callable and mandatory convertible preferred stocks, the valuation model is simplified since the value of security at maturity is known. For such convertibles the initial condition for Equation 5 is not the solution of the ordinary differential Equation 4, but the estimated value of the security at maturity.

Equation 5 is solved using dynamic programming. Certain events, such us common stock dividend payments or decreases in the conversion ratio or call price can trigger conversion of the preferred. Conversion prior to an event date may maximize the preferred value and, hence, can be optimal. Such a situation can be modeled as:

$$g(V,\tau^{+}) = Max\left[g(V-D,\tau^{-}),\gamma(\tau^{+})V\right] \tag{6}$$

where: τ^{+} and τ^{-} indicate time to maturity immediately before and after the event, and *D* is the common stock dividend.

On a preferred dividend date the preferred's value depends on the fact if the call protection period is active or not. When the preferred is non-callable, the pre-dividend value equals the post-dividend value plus the preferred dividends *I*:

$$g(V,\tau^{+}) = g(V-I,\tau^{-}) + I \tag{7}$$

When the preferred is callable, the firm may exercise its call option prior to an event date (preferred ex-dividend date or an increase in the conversion ratio or call price) in order to minimize the preferred's value and maximize the common stock's value:

$$g(V,\tau^{+}) = Min\left[g(V-I,\tau^{-}) + I, k(\tau^{+})\right] \tag{8}$$

Equations 4 and 5 do not have closed form solutions except for special cases (Ramanlal, Mann, and Moore, 1998), hence numerical techniques have to be utilized to obtain the preferred's price $g(V,\tau)$. The ordinary differential Equation 4 can be approximated by the difference equation:

$$a_i f_{i-1} + b_i f_i + c_i f_{i+1} = d, i = 1,\ldots,n-1 \tag{9}$$

where:

$a_i = rhi - \sigma^2 hi^2 - C$, $b_i = 2rh + 2\sigma^2 hi^2$, $c_i = -rhi - \sigma^2 hi^2 + C$, $d = 2ch$, and $f(V) = f(ih) = f_i$.

The cash flows C and c can depend on the firm's value V, which in turn depends on i. h is the step size for changes in the firm value V and n is the number of steps corresponding to the maximum value of V. Equation 9 represents (n - 1) linear equations with (n + 1) unknown f_i, i = 0,1,...,n that can be solved subject to the boundary conditions $f_0 = 0$, $f_i \leq k$, and $f_i \geq \gamma ih$.

The partial differential Equation 5 can be approximated by the difference equation:

$$a_i g_{i-1,j} + b_i g_{i,j} + c_i g_{i+1,j} = d_{i,j}; i = 1,...,n-1; j = 1,...,m \tag{10}$$

where:

$a_i = (rwi - \sigma^2 wi^2)/2$, $b_i = 1 + rw + 2\sigma^2 wi^2$, $c_i = -(rwi + \sigma^2 wi^2)/2$, $d_{i,j} = g_{i,j-1}$, and $g(V,\tau) = g(ih, jw) = g_{i,j}$. h and w are step sizes for changes in the firm value V and time to maturity γ, n and m are the maximum number of steps. Also, $k(\tau) = k(jk) = k_j$ and $\gamma(\tau) = \gamma(jk) = \gamma_j$. Equation 10 represents (n - 1) linear equations with (n + 1) unknowns $g_{i,j}$, i = 0, 1, …, n for each value of j that can be solved subject to the boundary conditions $g_{0,j} = 0$, and, when non-callable, $(g_{n,j} - g_{n-1,j})/h = \gamma_j$, or $g_{i,j} \leq k_j$ and $g_{i,j} \geq \gamma_j ih$ when callable. Setting the initial condition $g_{i,0} = f_i$, $g_{i,j}$ can be solved with iterations for all j starting with j = 1. The effects of periodic cash flows, changing conversion terms and call price are accounted for using Equations 6,7, and 8.

The estimation of the model value of the preferred stock $g(V, \tau)$ requires the following data:

$V(\tau)$ - the aggregate market value at time to maturity τ of the firm's outstanding equity securities (common and all preferred stocks including the issue to be valued).

D - the aggregate dividend payment of common stock and all preferred stock issues excluding the issue to be valued.

I - the aggregate dividend payment of the preferred stock to be valued.

C - the annualized value of $D + I$.

c - the annualized value of I.

$k(\tau)$ - the call price plus accrued dividends at time to maturity (the aggregate outlay that would be necessary if the entire issue were called).

$\gamma(\tau)$ - the conversion ratio at time to maturity (the fraction of aggregate equity that would be held by the convertible issue's owner if the entire issue were converted). $\gamma = n/(n+N)$, where N is the number of shares of common stock outstanding and n is the aggregate number of shares that the convertible issue can be exchanged in.

σ^2 - the variance of the instantaneous return dV/V (estimated as the sample variance of $\ln(V_t / V_{t-1})$).

r - the estimated rate of a 30-year zero-coupon Treasury bond.

As noted by Ramanlal, Mann, and Moore (1998), the preferred's model value is a function of the market value of equity, which in turn depends on the preferred's market value. To avoid potential bias, the value of equity is calculated as the market value of all equity and the model value of the preferred.

Analysis of Market-Model Pricing Errors

Since the Ramanlal, Mann, and Moore model was extensively tested and resulted in superior pricing performance, I assume that the model is unbiased predictor of market prices. Accordingly, I estimate the pricing error for issue *i* on date *t* as:

$$ERROR_{i,t} = \frac{(Market\ Price_{i,t} - Model\ Price_{i,t})}{Model\ Price_{i,t}} \tag{11}$$

Thus a negative value for *ERROR* in (11) indicates market underpricing.

To further assess the underpricing I examine the pricing errors using pane-data analysis. There are several advantages to panel data analysis: it helps avoid “aggregation bias” that may occur when means are compared; it can measure effects generally overlooked by a pure cross-section or pure time-series analysis; and it can control for unobserved heterogeneity.

Daily pricing errors are examined to see if convertibles display underpricing (relative to prices over the two-year period) in the first five days, the first four weeks, and the first six months following issuance, respectively.

The following models are estimated:

$$ERROR_{i,t} = a + \sum_{n=1}^{n=5} b_n D_{n,t} + e_{i,t} \tag{12}$$

$$ERROR_{i,t} = a + \sum_{n=1}^{n=4} b_n W_{n,t} + e_{i,t} \tag{13}$$

$$ERROR_{i,t} = a + \sum_{n=1}^{n=6} b_n M_{n,t} + e_{i,t} \tag{14}$$

where:

D1-D5: Dummy variables corresponding to first to fifth trading days after issuance;

W1-W2: Dummy variables corresponding to first to fourth weeks after issuance;

M1-M6: Dummy variables corresponding to first to sixth months after issuance.

Including period dummies permits identifying underpricing over varying periods: short (indicated by coefficients of D1-D5), intermediate (coefficients of W1-W4), or over a longer period up to six months (coefficients of M1-M6).

Next, I examine cross-sectional variation of our underpricing results. In particular, I examine how the underpricing of convertibles varies according to five chosen factors that characterize the issue: *NIGR* – non-investment grade or non-rated convertible as per S&P classification; *NOTC* – issues traded on NASDAQ and OTC; *SCAP* – small cap firm issues as per S&P classification; *NERP* – issues underwritten by non-reputable investment bankers as per Carter-Manaster rank; and *SSIZE* – issues with less than $50 million in offering proceeds.

I estimate the following models, which are extensions of (12), (13), and (14):

$$ERROR_{i,t} = a + \sum_{n=1}^{n=5} b_n D_{n,t} + \sum_{n=1}^{n=5} b_{n+5} Z_i D_{n,t} + e_{i,t} \tag{15}$$

$$ERROR_{i,t} = a + \sum_{n=1}^{n=4} b_n W_{n,t} + \sum_{n=1}^{n=4} b_{n+4} Z_i W_{n,t} + e_{i,t} \tag{16}$$

$$ERROR_{i,t} = a + \sum_{n=1}^{n=6} b_n M_{n,i,t} + \sum_{n=1}^{n=6} b_{n+6} Z_i M_{n,t} + e_{i,t} \tag{17}$$

where Z_i is the characteristic dummy for convertible security *i*. The model is estimated successively five times for Z_i corresponding to *NIGR*, *NOTC*, *SCAP*, *NREP*, and *SSIZE*.

The Z_i characteristic dummy in (15), (16), and (17) captures an interaction effect: the coefficients of $Z_i D_n$, $Z_i W_n$ and $Z_i M_n$ indicate how convertible underpricing in first several days, weeks and months following issuance, respectively, depends on the convertible characteristics.

Empirical Analysis

Convertible Preferred Stock Performance Following Issuance

In assessing security-performance following issuance, the time period when performance is assessed as well as the benchmark for expected performance must be specified. In particular, most studies of Initial Public Offerings and Seasoned Offerings of equities evaluate performance in a brief period following issuance against an estimated benchmark model for common stock returns.

For convertible securities, both the assessment period and the benchmark model are not readily obvious. For example, Loderer, Sheehan and Kadlec (1991) assess convertible preferred stock performance for 1-day, 5-day and 30-day holding periods following issuance utilizing the CRSP Value Weighted Index as the benchmark. Kang and Lee (1996) assess convertible debt performance for 1-day, 125-day and 250-day holding periods following issuance against the Merrill Lynch Convertible Bond Index.

In both previous cases, it is recognized that convertible security performance has the potential to deviate from expectations for extended periods up to one year, probably due to the fact that they are complex derivative securities whose risk-adjusted performance is difficult for investors to assess compared to the underlying common. Further, the benchmark model in each case is not specific to the security at hand; it is an Index and so the power of any test to measure relative performance is lowered.

In this section, excess returns of convertible preferreds relative to their underlying common stock are assessed for holding periods up to one year. In utilizing the underlying common as benchmark, the power to assess individual-security abnormal performance is increased, but results will be biased: in particular, convertibles have lower risk than their underlying common, thus in the absence of abnormal performance by the convertible, excess returns will be negative on average. However, positive and significant excess returns would be clear indication of supra-normal performance.

Further, by examining excess performance of convertibles relative to their underlying common, the "higher betas" hypothesis (Goldman Sachs, 2001) is addressed. In particular, it is hypothesized that the high performance of convertible preferreds as a group relative to common equity may be driven by the fact that whereas the benchmark equity portfolio has a beta close to unity, convertible preferreds as a group are issued by firms whose common-stock betas are larger.

Holding-Period Return Analysis

I examine first-day and buy-and-hold returns of convertible preferreds relative to their underlying common stocks. Buy-and-hold returns are assessed for periods of one week, and from one to twelve months following issuance in monthly increments.

The first-day return is calculated using the offer price (for the convertible) and the first-day mid-spread closing prices. For buy-and-hold returns, the first-day mid-spread closing prices and the last-day mid-spread closing prices of the specified periods are used. First-day returns are not included in the calculation of buy-and-hold returns. This permits clear segregation of abnormal performance.

Excess returns ($ERET_i$) are calculated as follows:

$$ERET_i = CVR_i - COMR_i = \left[\frac{CVP_2}{CVP_1} - 1\right] - \left[\frac{COMP_2}{COMP_1} - 1\right] \qquad (18)$$

where: CVR_i and $COMR_i$ are the convertible and underlying common returns for security *i*; CVP_1 and CVP_2 ($COMP_1$ and $COMP_2$) are beginning- and end-of-period mid-spread closing prices, respectively, of the convertible (underlying common).

Convertible preferreds have fixed-income security characteristics; as such, I also estimate excess returns controlling for interest-rate changes:

$$\begin{aligned} ERET_i &= RATE_i + e_i \\ e_i &= ERETadj_i \end{aligned} \tag{19}$$

where: $RATE_i$ is the change in the 30-year zero-coupon Treasury rate over the measurement period. Residuals in (2) represent adjusted excess returns ($ERETadj_i$) not explained by changes in interest rates.

<u>Cross-Sectional Variations in Holding-Period Returns</u>

In addition to general holding-period return analysis, I examine factors that potentially contribute towards the cross-sectional variation of these excess returns. Five factors are chosen based on the extant literature: investment rating, exchange listing, firm size, underwriter reputation, and size of the issue. I examine impact of these factors on excess returns and adjusted excess returns:

$$ERET_i = a + b_1 NIGR_i + b_2 NOTC_i + b_3 SCAP_i + b_4 NREP_i + b_5 SSIZE_i + e_i \tag{20}$$

$$ERETadj_i = a + b_1 NIGR_i + b_2 NOTC_i + b_3 SCAP_i + b_4 NREP_i + b_5 SSIZE_i + e_i \tag{21}$$

where:

NIGR: Non-investment grade or non-rated convertible dummy as per S&P classification

NOTC: Dummy indicating issues traded on NASDAQ and/or OTC

SCAP: Small cap firm dummy as per S&P classification;

NREP: Dummy indicating non-reputable investment banker as per Carter-Manaster rank

SSIZE: Dummy indicating issues with less than \$50 million in offering proceeds.

Next, I consider a variation of models (20) and (21) that is more informative:

$$\begin{aligned} CVR_i = a &+ b_1 RATE_i + b_2 COMR_i \\ &+ b_3 NIGR_i + b_4 NOTC_i + b_5 SCAP_i + b_6 NREP_i + b_7 SSIZE_i + e_i \end{aligned} \tag{22}$$

$$\begin{aligned} CVR_i = a &+ b_1 RATE_i + b_2 COMR_i \\ &+ b_3 NIGR_i + b_4 (NIGR_i \times COMR_i) \\ &+ b_5 NOTC_i + b_6 (NOTC_i \times COMR_i) \\ &+ b_7 SCAP_i + b_8 (SCAP_i \times COMR_i) \\ &+ b_9 NREP_i + b_{10} (NREP_i \times COMR_i) \\ &+ b_{11} SSIZE_i + b_{12} (SSIZE_i \times COMR_i) + e_i \end{aligned} \tag{23}$$

The key difference between (22) and (23) versus (20) and (21) is that the coefficient of $COMR_i$ is no longer constrained to unity. By permitting explicit dependence on common stock returns in (22), I am able to assess sensitivity of the convertible to its underlying common.

Furthermore, by including the cross terms in (23), I am able to investigate how sensitivity of the convertible to the underlying common depends on the five chosen factors (*NIGR, NOTC, SCAP, NREP and SSIZE*) that characterize the issue. For example, if the coefficient b_4 in (23) is significantly greater than zero, then the convertible's sensitivity to common stock returns is greater for non-investment-grade issues (measured by the sum $b_2 + b_4$) relative to investment-grade issues (measured by b_2).

Motivation for this extension is straightforward. Risk of the convertible security is derived in large measure from the underlying common stock; the risk can therefore be measured by sensitivity of convertible security returns to common stock returns. Model (23) allows us to evaluate the extent to which the convertible's returns are explained by increased sensitivity to the common stock owing to the various chosen factors. Increased sensitivity according to the chosen factors may be further investigated for different holding periods. In short, (23) allows us to assess how convertible returns are impacted by the increased risk of the convertible arising from its increased sensitivity to the underlying common depending upon the chosen factors and holding periods.

Following the IPO underpricing literature in relation to equities, I expect small-firm, non-investment-grade, small-size, and traded-on-NASDAQ/OTC issues to be more underpriced relative to their counterparts thereby offering larger returns following issuance. The evidence in relation to the underpricing of issues underwritten by reputable versus non-reputable investment bankers is mixed. For example, Carter and Manaster (1990) and Carter, Dark, and Singh (1998) report that in 1980s, more reputable underwriters were associated with lower underpricing. This relation is however reversed in the early 1990s as reported by Beatty and Welch (1996), Cooney et al. (2001) and Loughran and Ritter (2004). Accordingly, if convertibles follow equity IPO patterns, their underpricing in our sample is expected to be larger for more reputable underwriters.

Panel-Data Analysis of Daily, Weekly and Monthly Convertible Returns

The previous analysis focuses on cross-sectional variation of holding-period returns for up to 12 months following issuance. In this section, I investigate the source of excess returns to convertibles in early periods following issuance based on panel data analysis of daily, weekly and monthly returns. I focus on daily, weekly, and monthly returns because holding period returns tend to obscure effects that hold over shorter return intervals especially when these effects change with time; in particular, holding period returns aggregate time-varying effects. Panel data analysis is particularly suited for the issues at hand since it combines analysis of cross-sectional and time-series data: I am interested in the time-series variation of convertible returns as well as how this variation is impacted cross-sectionally.

There are several advantages to panel data analysis: it allows use of more observations for the analysis; it helps avoid "aggregation bias" that may occur when means are compared; it can measure effects generally overlooked by a pure cross-section or pure time-series analysis; and it can control for unobserved heterogeneity.

Analysis of Daily, Weekly and Monthly Returns in Early Periods Following Issuance

The returns of convertibles and the underlying common are calculated using the mid-point of daily closing bid and ask prices for the two-year period following issuance; they are analyzed to see if convertibles display excess returns (relative to returns over the two-year period) in the first five days, the first four weeks, and the first six months following issuance, respectively. I also test whether the convertible returns in these early periods following issuance are driven by the convertible's increased sensitivity to the underlying common.

The following models are estimated:

$$CVRD_i = a + b_1 RATE_i + b_2 CORD_i + \sum_{n=2}^{n=5} b_{n+1} D_n + e_i \quad (24A)$$

$$CVRD_i = a + b_1 RATE_i + b_2 CORD_i + \sum_{n=2}^{n=5} b_{n+1} D_n + \sum_{n=2}^{n=5} b_{n+5} D_n CORD_i + e_i \quad (24B)$$

$$CVRD_i = a + b_1 RATE_i + b_2 CORD_i + \sum_{n=1}^{n=4} b_{n+2} W_n + e_i \quad (25A)$$

$$CVRD_i = a + b_1 RATE_i + b_2 CORD_i + \sum_{n=1}^{n=4} b_{n+2} W_n + \sum_{n=1}^{n=4} b_{n+6} W_n CORD_i + e_i \quad (25B)$$

$$CVRD_i = a + b_1 RATE_i + b_2 CORD_i + \sum_{n=1}^{n=6} b_{n+2} M_n + e_i \quad (26A)$$

$$CVRD_i = a + b_1 RATE_i + b_2 CORD_i + \sum_{n=1}^{n=6} b_{n+2} M_n + \sum_{n=1}^{n=6} b_{n+8} M_n CORD_i + e_i \quad (26B)$$

where:

$CVRD_i$: Daily convertible returns for security *i* using mid-spread closing prices;

$CORD_i$: Daily underlying common returns for security *i* using mid-spread closing prices;

$RATE_i$: Corresponding changes in estimated 30-year zero-coupon Treasury rates;

D2-D5: Dummy variables corresponding to second to fifth trading days after issuance;

W1-W4: Dummy variables corresponding to first to fourth weeks after issuance;

M1-M6: Dummy variables corresponding to first to sixth months after issuance.

Models A in (24), (25), and (26) include only period dummies; this allows to see if convertibles offer excess return in the early periods following issuance relative to the two-year estimation period. The corresponding models B contain interaction terms, in particular, to see if the early-period excess returns are driven by increased sensitivity of the convertible to the underlying common. (24) estimates excess returns in days 2 though 5 following issuance; (25) estimates excess returns in weeks 1 through 4 following issuance; and (26) estimates excess returns in months 1 through 6 following issuance. Models (25) and (26) are also estimated with weekly returns without week one dummy variable in (25) for obvious reason. Also, model (26) is estimated with monthly returns (without first month dummy variables).

Cross-Sectional Analysis of Daily, Weekly, and Monthly Returns Following Issuance

In this section, I examine cross-sectional variation of the sensitivity results. In particular, I examine how the increased sensitivity of daily convertible returns to the underlying common during the first six months following issuance various according to five chosen factors (*NIGR, NOTC, SCAP, NREP and SSIZE*) that characterize the issue.

I estimate the following model, which is an extension of (26B):

$$\begin{aligned} CVRD_i = a + b_1 RATE_i + b_2 CORD_i + \sum_{n=1}^{n=6} b_{n+2} M_n + \sum_{n=1}^{n=6} b_{n+8} M_n CORD_i \\ + b_{15} Z_i + \sum_{n=1}^{n=6} b_{n+15} Z_i M_n + \sum_{n=1}^{n=6} b_{n+21} Z_i M_n CORD_i + e_i \end{aligned} \tag{27}$$

where Z_i is the characteristic dummy for convertible security *i*. The model is estimated successively five times for Z_i corresponding to *NIGR* for non-investment grade issues, *NOTC* for NASDAQ/OTC traded convertibles, *SCAP* for small capitalization firm issues, *NREP* for convertibles underwritten by non-highly reputable investment bankers, and *SSIZE* for issues with less than $50 million offering size.

The Z_i characteristic dummy in (27) introduces two types of interactions: the coefficients of $Z_i M_n$ indicate how daily excess returns in months 1 through 6 following issuance depend on the convertibles' characteristics; and coefficients of $Z_i M_n CORD_i$ show how sensitivity of the convertible to the underlying common in months 1 through 6 following issuance varies according to these same characteristics.

I also estimate model (27) with weekly and monthly returns (without first month dummy variable for monthly return estimation).

Historical Price Track Method

Mispricing of convertible securities is difficult to assess because the benchmark model is invariably complex. Nevertheless, a practical method favored among convertible trading desks for making short-term investment decisions that capitalize on mispricing is the so-called historical price track method discussed in (Calamos, 1998). In particular, the method recognizes the nonlinear relationship between convertible prices and prices of the underlying common stock, and models this relationship by a logarithmic regression.

The model has limitations. Significant changes in interest rates and/or volatility will pull convertible prices off its recent track. The pricing relation will also be impacted if there is a change in convertible's call and/or conversion terms; for example, if the issue becomes callable or the conversion terms change according to contractual stipulation.

Impact of changes in the convertible's call and/or conversions terms are less problematic since I examine prices immediately following issuance when contractual features are unlikely to change for several years hence. Limitations owing to changing interest rates and/or volatility are addressed by choosing smaller estimation periods and accordingly I am able to assess robustness of our results.

The following models are estimated:

$$CVP_i = a + b_1 LCOM_i + \sum_{n=1}^{n=5} b_{n+1} D_n + e_i \tag{28}$$

$$CVP_i = a + b_1 LCOM_i + \sum_{n=1}^{n=4} b_{n+1} W_n + e_i \tag{29}$$

$$CVP_i = a + b_1 LCOM_i + \sum_{n=1}^{n=6} b_{n+1} M_n + e_i \qquad (30)$$

where:

CVP_i: Daily convertible mid-spread closing price for security *i*;

$LCOM_i$: Logarithm of daily mid-spread closing price of the underlying common;

D2-D5: Dummy variables corresponding to second to fifth trading days after issuance;

W1-W4: Dummy variables corresponding to first to fourth weeks after issuance;

M1-M6: Dummy variables corresponding to first to sixth months after issuance.

Models (28), (29) and (30) are estimated using daily mid-spread closing prices for the two-year period following issuance. I investigate short-term (daily), intermediate (weekly) and long-term (monthly) underpricing of convertibles.

Volatility of Convertible Preferreds versus Common Stocks

Holding-period returns and daily, weekly, and monthly returns analysis does not account for the differential risk of convertibles relative to the common. To shed light on how the findings may differ for risk-adjusted excess returns, I estimate volatility of the convertible relative to its underlying common, in particular, the ratio $\gamma = \sigma_{cv} / \sigma_{com}$. My previous analysis of sensitivity of convertibles to the underlying common measures impact of “systematic” risk; volatility estimates provided in this section indicate implications of “total” risk.

Volatility is measured using daily closing mid-spread prices. To ensure stale price are not used, only those days when trading occurs are included in our sample. The sample period is 480 trading days (2 years) following issuance. Volatility is measured in 60-day windows on a rolling basis: the volatility estimate for the n^{th} day is calculated using daily prices for the immediately prior 60 trading days. For each rolling sixty-day period, daily returns are calculated; only returns calculated based on consecutive trading days are included. Daily volatility in a sixty-day period is calculated if there 30 valid daily returns.

CHAPTER FOUR: DATA ANALYSIS

Sample Design

Two samples of convertible preferred stocks are examined: The first sample of 24 securities are those outstanding at some point in time between 1982 and 1988 utilized in Ramanlal, Mann and Moore's (1998) original study. The second sample of 69 securities, collected specifically for this study, was issued sometime between January 1992 and July 2002. Analyzing two samples increases the robustness of our findings.

Sample One

Sample one was initially composed of all convertible preferred stock issues listed on the New York Stock Exchange (NYSE) at some point during 1982-1988, based on entries in Standard & Poor's *Daily Stock Price Record* for each of these years. A total of 185 issues were identified. Price histories of two years following issuance are examined. Then, the sample was screened by Ramanlal, Mann, and Moore (1998) to insure that sufficient data existed for valuation according to the following criteria. Specifically, the issue must:

(a) have a fixed dividend rate (only four convertible issues were found not to have a fixed dividend rate);

(b) be convertible into the common stock of the issuing firm only (not a subsidiary);

(c) not be exchangeable for debt or any other security;

(d) have all significant contingent claims traded on the NYSE in order to determine firm value in the model;

(e) be an industrial firm with clearly stated call and conversion provisions described in *Moody's Industrial Manual*; and

(f) must have sufficient daily trading volume, define as a minimum of 30 data points per quarter in order to estimate the return variance.

The selection criteria resulted in identification of 24 callable, convertible issues. I limit study to daily prices of these issues for two years following issuance for a total of 12,051 observations. Summary statistics are presented in Table 4. The mean ratio of the market value of preferred to common stock is 0.174 (median 0.132) at issuance, thus the issues comprise significant portions of the firm's capital structures. Issue dates range from 1967 to 1986.

Table 4. Convertible Preferreds in Sample 1: Issues, Issuance Dates, Market Values and Dates of First Call.

Issue/Series/Dividend	*Issue Date*	*Market Value Common Stock (million)*	*Market Value Convertible Preferred Stock (million)*	*Date When First Callable*
Allegheny Intl. $11.25	Jan-82	$286.90	$239.70	Jan-85
Allied Corp Series C $6.74	Jul-81	$2,325.00	$215.90	Aug-86
Allied Corp Series D $12.00	Oct-81	$2,325.00	$145.40	Oct-86
Anheuser-Busch $3.60	Nov-82	$5,260.00	$578.40	Nov-87
Arvin Ind. $2.00	Apr-76	$110.80	$21.36	Apr-78
Assoc. Dry Goods Series A $4.75	May-81	$868.60	$255.90	May-86
Bell & Howell Series A $.60	Nov-83	$230.10	$110.50	Jan-98
Castle & Cooke $.90	Jul-85	$1,076.00	$272.80	Sep-88
Chromalloy $5.00	Jun-68	$245.10	$90.24	Aug-72
Cluett Peabody $1.00	Aug-68	$282.30	$29.63	Oct-73
B. F. Goodrich Series A $3.50	Nov-86	$1,228.00	$116.70	Jan-90
Ingersoll-Rand $2.35	Jan-69	$986.10	$125.80	Jan-74
Koppers $10.00	Dec-80	$537.20	$60.70	Dec-83
Lafarge $2.44	Nov-83	$345.60	$28.65	Anytime
Libbey Owens Ford Series A $4.75	Sep-68	$401.50	$79.12	Jan-74
Mark Controls Series A $1.20	Oct-77	$47.32	$18.71	Oct-81
Moore-McCormack $10.00	Dec-83	$200.70	$34.36	Dec-86
Munford, Inc. 4%	Nov-68	$23.94	$6.82	Dec-73
Savin Series A $1.50	Dec-79	$86.03	$8.93	Anytime
Sun Co. $2.25	Oct-68	$2,994.00	$ 406.80	Anytime
Time, Inc. Series B $1.575	Nov-78	$1,475.00	$257.60	Jul-86
Time, Inc. Series C $4.50	Jan-81	$1,800.00	$181.40	Anytime
U.S. Gypsum $1.80	Dec-67	$447.00	$47.81	Jan-74
F. W. Woolworth Series A $2.20	Mar-69	$776.90	$72.15	Jan-76

The sample includes all convertible preferred issues listed in the New York Stock Exchange (NYSE) at some point during 1982-1988, based on entries in Standard & Poor's *Daily Stock Price Record* for each of these years. All issues meet the following criteria: (1) convertible into common stock of the issuing firm only (not a subsidiary or another firm), accordingly, all exchangeable issues and issues associated with mergers and acquisitions were omitted; (2) not exchangeable for debt or any other security; (3) have all significant contingent claims traded on the NYSE in order to determine firm value in the model; (4) be an industrial firm wit clearly stated call and conversion provisions described in *Moody's Industrial Manuals*; (5) have a fixed dividend rate; and (6) have sufficient daily trading volume, defined as a minimum of 30 data points per quarter in order to estimate the return variance. Market values of convertible preferreds are based on offer price; market values of common stocks are based on first-day trading prices.

Sample Two

Sample two was initially composed of all convertible preferred stock issues available in the Bloomberg database that were issued at some point between January 1992 and July 2002. A total of 156 issues were identified. Daily price histories up to two years following issuance are examined. The sample was screened for appropriateness of the security and data sufficiency. Specifically, I selected issues:

(a) convertible into common stock of the issuing firm only (not a subsidiary or another firm), accordingly, all exchangeable issues and issues associated with mergers and acquisitions were omitted;

(b) not exchangeable for debt or any other security;

(c) with closing transaction prices and matching quotes available in Bloomberg or CRSP for the convertible and the underlying common stock; and

(d) with sufficient daily trading volume, defined as a minimum of 30 data points per quarter in order to estimate the return variance.

In addition, the convertibles were verified to have fixed dividend payments, and the market value of all contingent claims for those firms that had multiple claims was obtained to determine the firm's value.

The selection criteria yielded 69 convertible preferred stock issues. Information including the convertibles contract features, offer price, issue size, investment rating, exchange listing and underwriter were obtained from *Moody's (Mergent) Manuals* and SEC filings, and the online service by Preferreds Online. Total number of observations in sample two is 28,831.

The sample of 69 securities with summary statistics is listed in Table 5. Market values of convertible preferreds and corresponding common stocks are for the first day that convertibles trade. The distribution of issue dates indicate that the sample is evenly distributed over the ten-year sampling period. The mean ratio of the market value of preferred to common stock is 0.225 (median 0.175) at issuance indicating that in sample two the issues also comprise significant portion of the firm's capital structures. Almost all issues have significant call-deferred periods hence there are no significant changes in the issues' contractual characteristic during the two-year estimation period.

Table 5. Convertible Preferreds in Sample 2: Issues, Issuance Dates, Market Values and Dates of First Call

Issue/Series/Dividend	*Issue Date*	*Market Value Common Stock (million)*	*Market Value Convertible Preferred Stock (million)*	*Date When First Callable*
Union Planters Series E $2.00	Feb-92	$244.33	$88.28	Mar-97
Westmoreland Coal Co $2.125	Jul-92	$98.48	$50.13	Jul-96
Goodrich Petrol $0.80	Sep-92	$33.60	$11.46	Sep-94
Capstead Mortgage Series B $1.26	Dec-92	$579.67	$408.58	Dec-97
Hecla Mining Series B $3.50	Jun-93	$404.71	$119.46	Jul-96
WHX Series A $3.25	Jun-93	$342.07	$157.13	Jun-96
Freeport-McMoran C&G $1.75	Jul-93	$1,242.10	$35.26	Anytime
North Coast Life Insurance $1.00	Aug-93	$10.10	$3.49	Oct-95
ICO $1.69	Nov-93	$55.65	$33.22	Dec-96
Wellsford Residential Property $1.75	Nov-93	$259.41	$98.26	Nov-98
National Health $2.125	Feb-94	$345.69	$57.94	Feb-99
Western Gas Resources $2.625	Feb-94	$815.55	$140.25	Feb-97
First Merit Corp Series B $1.625	Jun-94	$644.23	$13.31	Jun-99
WHX Series B $3.75	Sep-94	$631.56	$174.79	Oct-97
The Producers Entertainment Group $0.425	Dec-94	$8.90	$4.49	None

Issue/Series/Dividend	*Issue Date*	*Market Value Common Stock (million)*	*Market Value Convertible Preferred Stock (million)*	*Date When First Callable*
Dynex Series A $2.34	Jun-95	$394.03	$33.08	Jun-98
Dynex Series B $2.34	Oct-95	$433.43	$48.69	Oct-98
Callon Petroleum Series A $2.125	Nov-95	$56.10	$33.22	Dec-98
Citizens Communication $2.50	Jan-96	$870.56	$202.52	Feb-99
Felcor Lodging Series A $1.95	Apr-96	$663.41	$147.47	Apr-01
NorAm Financial $3.125	Jun-96	$1,248.04	$153.95	Jun-00
Criimi MAE Series B $2.72	Aug-96	$326.88	$62.19	Aug-06
Dynex Series C $2.92	Oct-96	$606.69	$55.32	Sep-99
First Union RE Series A $2.10	Oct-96	$123.33	$58.80	Oct-01
Nuevo Financial $2.875	Dec-96	$875.10	$119.46	Dec-99
Jameson Inn Series S $1.70	Jan-97	$115.10	$29.91	Feb-00
Rouse Co Series B $3.00	Feb-97	$2,010.12	$200.50	Apr-00
National Australia Bank $1.97	Mar-97	$205.14	$89.15	Mar-07
Vornado Realty Series A $3.25	Apr-97	$1,660.05	$291.99	Apr-01
Commodore Separation Technologies $1.00	Apr-97	$46.72	$5.66	Apr-01
Kramont Realty Series B-1 $2.44	Jun-97	$169.24	$30.06	Feb-02
CNF Series A $2.50	Jun-97	$1,476.60	$133.76	Jun-00
National Mercantile Bancorp $0.65	Jul-97	$40.83	$13.73	Jun-00
Sinclair Broadcasting Series D $3.00	Sep-97	$287.99	$186.73	Sep-00
US Restaurant Properties Series A $1.93	Nov-97	$300.35	$92.46	Nov-02
Glenborough Realty Series A $1.94	Jan-98	$602.73	$261.90	Jan-03
Reckson Associates Series A $1.91	Apr-98	$948.52	$230.08	Apr-03
Crescent Real Estate $1.69	Feb-98	$3,830.42	$195.52	Feb-03
Equity Office Properties Series B $2.625	Feb-98	$5,212.91	$227.28	Feb-03
Dura Automotive $1.875	Mar-98	$185.50	$54.71	Mar-01
IXC Communications $3.375	Apr-98	$3,780.91	$157.58	Apr-00
Innkeepers USA $2.16	May-98	$370.60	$90.01	May-03
TXI Capital $2.75	Jun-98	$1,173.98	$199.64	Jun-01
Duke Realty Series D $1.84	Nov-98	$1,850.57	$143.11	Dec-03
Centerpoint Properties Series B $3.75	Jun-99	$720.15	$50.50	Jun-04
Emmis Communications Series A $3.125	Oct-99	$872.59	$152.20	Oct-02
Cincinnati Bell Series B $3.375	Nov-99	$3,780.91	$157.58	Apr-00
Cardinal Financial Series A $0.36	Nov-00	$18.58	$5.43	Mar-04
Smurfit-Stone Container Series A $1.68	Nov-00	$3,101.35	$73.04	Nov-00
Six Flags $1.8125	Jan-01	$1,588.37	$333.56	Feb-04
Northrop Grumman Series B $7.00	Apr-01	$6,802.56	$408.63	Apr-08
Electronic Data Systems $3.81	Jun-01	$27,835.85	$1,423.80	None
Hancock Holding Series A $1.60	Jul-01	$438.55	$40.69	Jul-06
Cendant Corporation $3.875	Jul-01	$17,824.27	$736.88	None
Commonwealth Bankshares I $0.40	Jul-01	$11.99	$8.01	Oct-06
Cornerstone Realty Income Series A $2.375	Aug-01	$513.73	$12.80	Jul-04
Cummings $3.50	Nov-01	$1,342.04	$300.00	Jun-06
IndyMac Bancorp $3.00	Nov-01	$1,462.83	$174.30	Nov-06
Prudential Financial $3.375	Dec-01	$16,705.85	$635.40	None
Solectron Corp $1.81	Dec-01	$7,086.47	$1,062.00	None
Reinsurance Group of America $2.875	Dec-01	$1,608.93	$222.08	Dec-04

Issue/Series/Dividend	*Issue Date*	*Market Value Common Stock (million)*	*Market Value Convertible Preferred Stock (million)*	*Date When First Callable*
Gabelli Asset Management $1.74	Jan-02	$233.17	$85.02	Feb-05
Ford Motor Company $3.25	Jan-02	$26,630.31	$4,671.00	Jan-07
Southern Community Capital $0.725	Feb-02	$57.54	$17.51	Mar-07
Chesapeake Energy $3.375	Apr-02	$1,367.62	$189.00	Nov-04
Temple-Inland $3.75	Apr-02	$2,578.81	$303.15	None
United Fire and Casualty $1.59	May-02	$331.57	$73.04	May-05
Phelps Dodge Series A $6.75	Jun-02	$3,047.92	$201.25	None
Corning Inc $7.00	Jul-02	$2,356.48	$153.84	None

The sample includes all convertible preferred issues available on Bloomberg that are issued at some point between January 1992 and July 2002 meet the following criteria: (1) convertible into common stock of the issuing firm only (not a subsidiary or another firm), accordingly, all exchangeable issues and issues associated with mergers and acquisitions were omitted; (2) not exchangeable for debt or any other security; and (3) with closing transaction prices and matching quotes available in Bloomberg or CRSP for the convertible and the underlying common stock. Market values of convertible preferreds are based on offer price; market values of common stocks are based on first-day trading prices.

Convertible Characteristics of Both Samples

Table 6 presents issue characteristics within each subsample: investment rating, exchange listing, firm size, underwriter reputation, offer size, and convertible type. Following Standard and Poor's and/or Moody's convention, sample two issues are spilt into two groups: investment versus speculative/nonrated grade issues. Exchange listing of convertibles is differentiated by NYSE/AMEX versus NASDAQ/OTC. Firm size is distinguished according to Standard and Poor's classification: firms with total market capitalization more than $5 billion at any point during the two-year period following issuance are classified as large capitalization; market values between $1 and $5 billion are classified as medium capitalization; and firms with less than $1 billion as small capitalization firms.

Underwriter reputation for sample two issues is assessed using Carter-Manaster (Carter and Manaster, 1990, and Carter, Dark, and Singh, 1998) and Megginson-Weiss (Megginson and Weiss, 1991) methodologies. Carter-Manaster rankings are estimated via relative placement in IPO tombstones from 1985 through 1991: the maximum ranking is nine and the minimum is zero. Megginson-Weiss measures are based on the market share for each underwriter: computed by the dollar amount of underwriting credited to an investment bank divided by total industry underwriting. Both rankings for 184 investment banks are listed in Carter, Dark, and Singh (1998). Convertible underwriters with Carter-Manaster ranks of 8 and 9 corresponding to the largest Megginson-Weiss market shares were assigned into the highly reputable underwriter group. Convertible issues that were underwritten by investment banks with ranks 7 and lower and unlisted underwriters were assigned into less reputable group. . Updated Carter-Manaster rankings for 1992-2000 period (which are contemporaneous to the current sample period) are provided in Loughran and Ritter (2004). The methodology used and the ranking of 1079 underwriters for the 1980-1984, 1985-1991, and 1992-2000 periods are available on Jay Ritter's website (http://bear.cba.ufl.edu/ritter). My classification of underwriter reputation is consistent with both the original and the updated studies.

Issues are split into three groups according to proceeds: offerings greater than $200 million, less than $200 million but greater than $50 million, and less than $50 million based on offer price are denoted large, medium, and small size, respectively. Sample one issues are distributed about evenly among these three groups. Large offerings fall in the top quartile and small offerings in the bottom quartile of sample two.

Four different types of convertible preferreds are identified in sample two: (1) conventional convertible preferred stock; (2) mandatory convertibles preferreds; (3) mandatory callable preferreds; and (4) non-callable preferred stock. Sample one is more homogeneous and consists of only conventional convertible preferred stocks.

Sample two issues were limited to those with available closing transaction prices plus the corresponding bid-ask quote data for convertibles and their underlying common stocks. Transactions prices are necessary to ensure that prices are not stale; however prices are calculated using mid-spread quotes. Mid-spread quotes provide a better measure of fundamental value and avoid the “bid-ask bounce” volatility bias (Roll, 1984). On the other hand, daily prices for sample one issues are not mid-spread quotes and represent the actual daily closing prices.

Table 6. Convertible Preferred Stocks Grouped by Issue Characteristics with Average Bid-Ask Spreads for the Preferred and Corresponding Common Stocks in Sample Two.

		Number of Convertible Preferred Offerings				
Groups	*Issues*	*Sample 1*	*Sample 2*	*Average Bid-Ask Spread for Convertibles in Sample 2*	*Average Bid-Ask Spread for Underlying Common Stocks in Sample 2*	*Common – Convertible Spread Difference in Sample 2*
By Rating	Investment Grade	N/A	13	0.46%	0.64%	0.18%
	Speculative Grade and Non-rated	N/A	56	0.91%	1.02%	0.11%
By Exchange	NYSE/AMEX traded	24	43	0.51%	0.69%	0.18%
	NASDAQ/OTC traded	0	26	1.37%	1.40%	0.03%
By Firm Size	Large Cap Firms	1	9	0.62%	0.98%	0.36%
	Medium Cap Firms	9	21	0.55%	0.70%	0.15%
	Small Cap Firms	14	39	1.01%	1.06%	0.05%
By Underwriter Reputation	Highly Reputable	N/A	38	0.50%	0.70%	0.20%
	Less Reputable	N/A	31	1.26%	1.28%	0.02%
By Offering Size	Large Size Offerings	7	18	0.44%	0.71%	0.27%
	Medium Size Offerings	9	34	0.57%	0.68%	0.11%
	Small Size Offerings	8	17	1.69%	1.70%	0.01%
By Type of Convertible Preferreds	Conventional Convertibles	24	46	0.93%	1.04%	0.11%
	Mandatory Convertibles	0	7	0.44%	0.93%	0.49%
	Mandatory Callable	0	16	0.69%	0.71%	0.02%
	Non-Callable	0	1	0.25%	0.43%	0.18%
	Total Number of Convertible Preferred Stocks	24	69	0.82%	0.95%	0.13%

Ratings based on S&P and Moody's; Large, medium, and small capitalization firms are those with more that $5 billion, less than $5 billion but more than $1 billion, and less than $1 billion market capitalization; Underwriter reputation based on Carter-Manaster and Megginson-Weiss measures; Large, medium, and small size offerings are those with more than $200 million, less than $200 million but more than $50 million, and less than $50 million in proceeds, correspondingly. Convertible preferred stocks are categorized as conventional, mandatory convertible, mandatory callable, and non-callable. Average relative spreads (spread divided by mid-spread quote) are provided for each group and subgroup.

The magnitude of the bid-ask spread allows us to determine if liquidity may be a contributing factor to the convertible security's excess returns. Amihud and Mendelson (1986) indicate that expected returns are increasing in the relative bid-ask spread (i.e., the spread divided by the mid-spread quote). By comparing relative spreads of convertibles versus their underlying common in sample two, I assess the necessity to control for differential liquidity in estimating the convertible's excess returns. Summary statistics are provided in Table 6. Interestingly, the average relative spread for convertibles (0.82%) is less than for common stock (0.95%). This result holds for all groups and subgroups of convertibles in sample two. Also, within each group, variation of spreads is as expected. For example, investment grade issues have lower spreads than speculative grade issues; NYSE/AMEX lower than NASDAQ/OTC; and correspondingly for all remaining groups.

Hasbrouck (1988) studies bid-ask spreads and distinguishes asymmetric-information and inventory-control effects. He finds that the spreads of low volume stocks are consistent with inventory-control behavior, while the spreads of high-volume stocks are mostly driven by the information content. Sample two is a perfect illustration of Hasbrouck's findings. Since, convertible preferred stocks carry fixed income component in their returns and can be converted into underlying common stocks, they have inherently less uncertainty about their future returns than their underlying common stocks have. This leads to smaller degree of informational asymmetry surrounding convertible preferred trading. If we use the size of a firm as a proxy for higher volume trading, sample two spreads are consistent with Hasbrouck findings: the common-convertible spread difference increasing with the size of a firm from 0.05% for small caps to 0.36% for large caps. If we use the size of an offering as a proxy for high and low volume stocks, the common-convertible spread difference also confirms that the reduced informational asymmetry is more important for large volume stocks than for low volume stocks.

In summary, I conclude it is not necessary to control for spreads, recognizing that estimates for excess returns, if they exists, will be depressed.

Analysis of Market-Model Pricing Errors

Results for (11) are presented in Table 7. The mean pricing error for the sample one convertibles is negative -0.51%. The mean pricing error of the same model in Ramanlal, Mann, and Moore (1998) study is (-0.18%). The discrepancy follows because I utilize only a portion of their sample (12,051 observations vs. 27, 544) and pricing errors in Ramanlal, Mann, and Moore were calculated as $ERROR_{i,t} = \frac{(Model\ Price_{i,t} - Market\ Price_{i,t})}{Market\ Price_{i,t}}$. The mean pricing error for sample two is 0.32%. Since the aim of this study is test for underpricing (in the six months) following issuance, the data are partitioned into subsamples according to time following issuance (1-120 vs. 121-480 trading days).

The mean pricing errors for the 1-120 day subsample is -1.98% (-0.67%) for sample one (sample two), whereas for the 121-480 day subsample it is -0.20% (0.72%) for sample one (sample two). The difference in mean pricing errors: mean (1-120 day subsample) – mean (121-480 day subsample) is -1.78% (-1.39%) for sample one (sample two) suggesting that convertible preferred stocks are underpriced between 1.39 and 1.78 percent on average for up to six months following issuance compared to the following eighteen months. The average first week trading price of convertible preferred stock is \$46 (\$35) in sample one (sample two). The underpricing is judged to be economically significant: 49-82 cents per preferred share.

Median pricing errors are comparable. The median pricing errors for the 1-120 day subsample is -1.92% (-1.16%) for sample one (sample two), whereas for the 121-480 day subsample it is -0.83% (0.312%) for sample one (sample two).

Table 7. Mean and Median Pricing Errors

	Sample 1				Sample 2			
	All sample	*1-120 trading days after issuance*	*121-480 trading days after issuance*	*Difference in means between 1-120 and 121-480 subsamples*	*All sample*	*1-120 trading days after issuance*	*121-480 trading days after issuance*	*Difference in means between 1-120 and 121-480 subsamples*
Mean	-0.51%	-1.98%	-0.20%	-1.78%*** (-13.85)	0.32%	-0.67%	0.72%	-1.39%*** (-16.69)
Median	-0.99%	-1.92%	-0.83%		0.13%	-1.16%	0.31%	

The pricing errors for each security *i* are calculated as: $ERROR_{i,t} = \dfrac{(Market\ Price_{i,t} - Model\ Price_{i,t})}{Model\ Price_{i,t}}$.

Both samples are partitioned according to time since issuance into 1-120 days and 121-480 subsamples. Means and medians are presented for two samples separately, with t-statistics in parentheses. *** indicate significance at the 1% level.

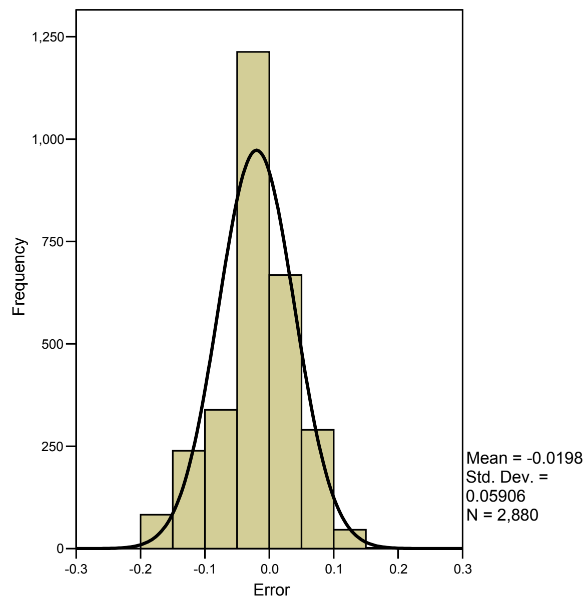
The problem of assessing statistical significance of differences arises when samples are very large as is the case here. As noted in Ramanlal, Mann, and Moore (1998), very large sample sizes almost surely results in rejection of the null hypothesis. Accordingly, Bayesian posterior odds ratios that tend to counteract the effects of the large samples are used to assess statistical significance in such cases (see also, Eades, Hess, and Kim, 1984; and Lee, 1989). I estimate the posterior probabilities that the mean errors of 1-120 day and 121-480 day subsamples are equal, versus the alternative (unequal). The null hypothesis H_0 is that the difference in means of pricing errors is zero, with associated prior and posterior probabilities. The alternative hypothesis H_1 is that the difference in means is not zero with associated prior and posterior probabilities.

Assuming that the difference in means is normally distributed under the null and alternative hypotheses, and with equal variance under each hypothesis, the posterior probability is $p_0 = \left[1 + B^{-1}\right]^{-1}$, where Bayes factor *B* for large number of observations *n* is approximately equal to $n^{1/2} \exp\left[-Z^2 / 2\right]$, where *Z* is normal theory test statistic (Lee, 1989). The test statistics (*Z*) for the two tests are – 13.85 (sample one) and – 16.69 (sample two). The corresponding posterior probabilities of the null hypothesis approach zero, hence the posterior odds ratios $p_1 / p_0 = (1 - p_0) / p_0$ approach infinity despite the large sample size. Thus we conclude that the differences in mean pricing errors between the 1-120 day and 121-480 day subsamples are statistically significant.

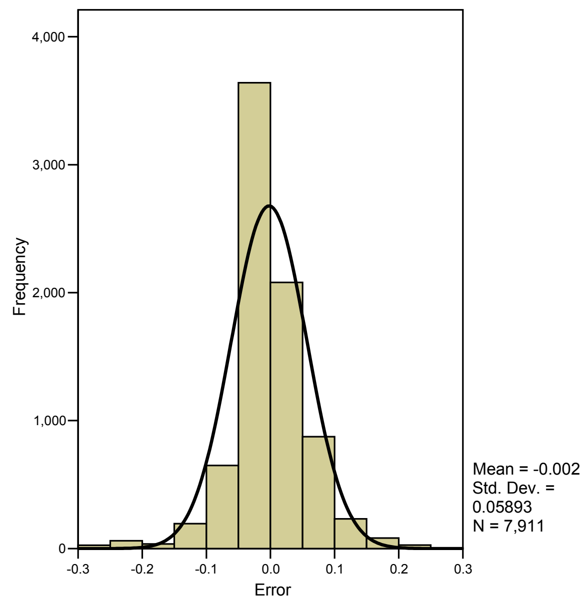
Frequency distributions of the errors in each of the subsamples are depicted as histograms in Figure 1. The horizontal axes are the same for all histograms to facilitate comparison. Panels A and B display data for sample one (corresponding to the 1-120 day and 121-480 day periods, respectively). Panels C and D display histograms for the corresponding periods in sample two.

For both sample one and sample two, it is evident that the distribution shifts to the right following the first 120-day period indicating an initial underpricing and a subsequent correction.

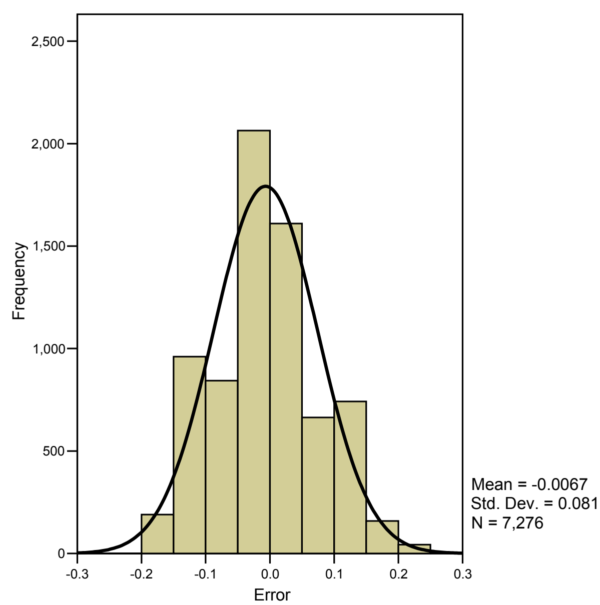
A. Sample 1: 1-120 Days Following Issuance



B. Sample 1: 121-480 Days Following Issuance



C. *Sample 2: 1-120 Days Following Issuance*



D. Sample 2: 121-480 Days Following Issuance

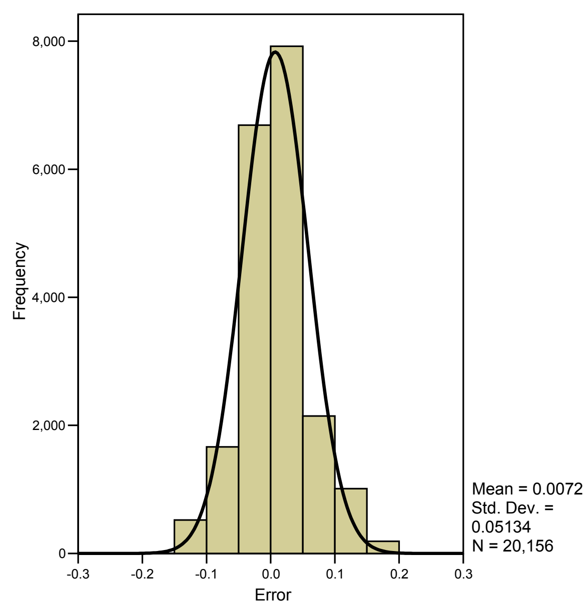


Figure 1. Frequency Distributions of the Errors.

Panel-Data Analysis of Pricing Errors

Following standard econometric practice, I use F-test, and the Hausman and Lagrange Multiplier (LM) tests for unobserved heterogeneity, and then select the appropriate type of panel-data analysis. F-tests and LM tests favor fixed effect and random effect models over pooled OLS, while Hausman tests favor random effect over fixed effect models in both samples. Accordingly, I utilize the random effect model for all following panel-data estimations.

Analysis of Pricing Errors in Early Periods Following Issuance

Parameter estimates for models (12), (13) and (14) are presented in Table 8 for both samples of convertible preferred stocks. Model (12) estimates indicate that securities are underpriced 1.61 percent (with marginal significance) on day three following issuance for sample one; for sample two, however, underpricing ranges from 1.35 percent to 1.87 percent over all five days following issuance (significant at the 1 percent level). These underpricing estimates are relative to the remainder of the two-year estimation period.

Model (13) estimates indicates significant underpricing (at the 1 percent level) for both samples for each of the four weeks following issuance. Underpricing ranges from 1.34 to 1.65 percent for the sample one and from 1.31 to 1.75 percent for sample two. Model (14) yields similar results: underpricing is significant (at the 1 percent level) for all six months following issuance, ranging from 1.39 to 2.87 (in month 2) percent for sample one and 1.22 to 1.84 (in month 1) percent for sample two. In both cases, underpricing is higher in early months then gradually tapering off (although not uniformly).

In all cases, for all three models and both samples, the constant coefficient is not significantly different from zero indicating that the model is well specified, i.e., other than the indicated underpricing, the average pricing errors are not significantly different from zero. This is consistent with the findings of Ramanlal, Mann and Moore (1998).

Table 8. Pricing Error of Convertible Preferred Stock Panel Estimate

Model (12)	*Constant*	*D1*	*D2*	*D3*	*D4*	*D5*	
Sample 1	-0.0050	-0.0122	-0.0126	-0.0161*	-0.0113	-0.0134	
	(-0.70)	(-1.28)	(-1.33)	(-1.70)	(-1.19)	(-1.41)	
Sample 2	0.0028	-0.0135***	-0.0165***	-0.0187***	-0.0185***	-0.0182***	
	(0.49)	(-3.00)	(-3.54)	(-3.96)	(-4.00)	(-3.89)	
Model (13)	*Constant*	*W1*	*W2*	*W3*	*W4*		
Sample 1	-0.0046	-0.0136***	-0.0165***	-0.0154***	-0.0134***		
	(-0.63)	(-3.19)	(-3.87)	(-3.62)	(-3.15)		
Sample 2	0.0033	-0.0175***	-0.0164***	-0.0139***	-0.0131***		
	(0.57)	(-8.43)	(-7.77)	(-6.61)	(-6.22)		
Model (14)	*Constant*	*M1*	*M2*	*M3*	*M4*	*M5*	*M6*
Sample 1	-0.0003	-0.0190***	-0.0287***	-0.0254***	-0.0160***	-0.0143***	-0.0139***
	(-0.03)	(-8.89)	(-13.39)	(-11.84)	(-7.49)	(-6.68)	(-6.51)
Sample 2	0.0063	-0.0184***	-0.0136***	-0.0149***	-0.0164***	-0.0137***	-0.0122***
	(1.10)	(-17.30)	(-12.52)	(-13.71)	(-15.16)	(-12.62)	(-11.23)

Panel-data analysis (random effect model) of pricing errors of convertible preferred stocks using equations:

$$ERROR_{i,t} = a + \sum_{n=1}^{n=5} b_n D_{n,t} + e_{i,t} \qquad (12)$$

$$ERROR_{i,t} = a + \sum_{n=1}^{n=4} b_n W_{n,t} + e_{i,t} \qquad (13)$$

$$ERROR_{i,t} = a + \sum_{n=1}^{n=6} b_n M_{n,t} + e_{i,t} \qquad (14)$$

where: the pricing error for issue *i* on date *t* is defined as $ERROR_{i,t} = \frac{(Market\ Price_{i,t} - Model\ Price_{i,t})}{Model\ Price_{i,t}}$, *D1-D5* are the first through fifth day of trading dummies, *W1-W4* are the first through fourth week trading dummies, and *M1-M6* are the first through sixth month trading dummies. Parameter estimates are presented for two samples separately, with t-statistics in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

Cross-Sectional Analysis of Pricing Errors

Parameter estimates for (15) are presented in Table 9. All coefficient estimates for $Z_i D_n$ for $Z = NIGR$ are statistically insignificant (sample two only); this indicates that underpricing ranging from 1.79% (marginally significant at the 10% level) for the first day of trading to 2.16% (significant at the 5% level) for the fifth trading day is invariant to security ratings. Similar results hold for $Z = NOTC$ (sample two only), i.e. the degree of underpricing does not depend on the exchange where the securities are traded.

Small cap issues on the other hand, are different from mid and large cap convertibles in a counterintuitive way. Both samples indicate (although only marginally significant for sample one) that mid and large cap issues are underpriced approximately 3 to 3½ percent during the first five days following issuance. However, almost all that underpricing is erased for small cap issues. For example, the coefficient of D_5 in the equation $Z = SCAP$ is statistically significant and negative: – 3.19% (-3.55%) for sample one (sample two), while the coefficient of $Z_i D_5$ is positive: 3.17% (3.07) for sample one (sample two). These coefficients indicate mid and large cap issues are underpriced about 3% on day five, while small cap issues are overpriced about 3% relative to mid and large cap issues suggesting that small cap convertibles are scarcely underpriced.

Underwriter reputation also influences underpricing of convertibles but this time in a more intuitive way. All coefficient estimates of D_n for $Z = NREP$ (sample two only) are statistically insignificant. In order words, issues underwritten by reputable investment bankers are not underpriced at issuance. In contrast, all coefficient estimates of $Z_i D_n$ for $Z = NREP$ are significantly negative (albeit only marginal for day 1) indicating that non-reputable underwriter issues are about 2 percent underpriced.

Pricing based on issue size yields mixed results for the two samples. For sample one, mid and large size issues are underpriced about 3 percent whereas small size issues are overpriced (relative to mid and large size issues) by about 5½ percent implying that small size issues are overpriced on average by 2½ percent. For sample two, however, both mid/large and small issues are underpriced about 1½ percent.

Table 9. Pricing Errors of Convertible Preferred Stock Panel Estimates with Convertible Characteristics and Daily Dummies.

	Z=NIGR		*Z=NOTC*		*Z=SCAP*		*Z=NREP*		*Z=SSIZE*	
	Sample 1	*Sample 2*	*Sample 1*	*Sample 2*	*Sample 1*	*Sample 2*	*Sample 1*	*Sample 2*	*Sample 1*	*Sample 2*
Constant	N/A	0.0028	-0.0122	0.0028	-0.0050	0.0028	N/A	0.0028	-0.0051	0.0028
		(0.49)	(-1.28)	(0.49)	(-0.70)	(0.49)		(0.49)	(-0.70)	(0.49)
D1	N/A	-0.0179*	-0.0126	-0.0162***	-0.0316**	-0.0288***	N/A	-0.0067	-0.0313***	-0.0130**
		(-1.75)	(-1.33)	(-2.85)	(-2.15)	(-4.21)		(-1.13)	(-2.69)	(-2.50)
D2	N/A	-0.0195*	-0.0161	-0.0178***	-0.0285*	-0.0332***	N/A	-0.0078	-0.0283**	-0.0151***
		(-1.91)	(-1.70)	(-3.09)	(-1.94)	(-4.77)		(-1.30)	(-2.44)	(-2.84)
D3	N/A	-0.0206**	-0.0113*	-0.0188***	-0.0351**	-0.0339***	N/A	-0.0087	-0.0337***	-0.0159***
		(-2.02)	(-1.19)	(-3.23)	(-2.39)	(-4.79)		(-1.41)	(-2.90)	(-2.96)
D4	N/A	-0.0219**	-0.0134	-0.0193***	-0.0302**	-0.0336***	N/A	-0.0096	-0.0306***	-0.0165***
		(-2.15)	(-1.41)	(-3.36)	(-2.06)	(-4.84)		(-1.59)	(-2.63)	(-3.11)
D5	N/A	-0.0216**	-0.0122	-0.0195***	-0.0319**	-0.0355***	N/A	-0.0094	-0.0317***	-0.0166***
		(-2.11)	(-1.28)	(-3.35)	(-2.17)	(-5.02)		(-1.53)	(-2.73)	(-3.08)
Z&D1	N/A	0.0054	N/A	0.0072	0.0334*	0.0269***	N/A	-0.0156*	0.0574***	-0.0020
		(0.48)		(0.77)	(1.73)	(2.97)		(-1.72)	(2.85)	(-0.19)
Z&D2	N/A	0.0038	N/A	0.0036	0.0273	0.0304***	N/A	-0.0215**	0.0472**	-0.0063
		(0.33)		(0.37)	(1.42)	(3.24)		(-2.26)	(2.34)	(-0.56)
Z&D3	N/A	0.0024	N/A	0.0003	0.0327*	0.0273***	N/A	-0.0244**	0.0527***	-0.0122
		(0.21)		(0.03)	(1.70)	(2.88)		(-2.55)	(2.62)	(-1.09)
Z&D4	N/A	0.0043	N/A	0.0023	0.0325*	0.0272***	N/A	-0.0217**	0.0579***	-0.0085
		(0.37)		(0.23)	(1.69)	(2.91)		(-2.31)	(2.88)	(-0.78)
Z&D5	N/A	0.0042	N/A	0.0037	0.0317*	0.0307***	N/A	-0.0210**	0.0548***	-0.0068
		(0.37)		(0.37)	(1.64)	(3.26)		(-2.22)	(2.73)	(-0.62)

Panel-data analysis (random effect model) of pricing errors of convertible preferred stocks using equation:

$$ERROR_{i,t} = a + \sum_{n=1}^{n=5} b_n D_{n,t} + \sum_{n=1}^{n=5} b_{n+5} Z_i D_{n,t} + e_{i,t} \qquad (15)$$

where: the pricing error for issue i on date t is defined as $ERROR_{i,t} = \frac{(Market\ Price_{i,t} - Model\ Price_{i,t})}{Model\ Price_{i,t}}$, *D1-D5* are the first through fifth day of trading dummies, *Z* is a convertible characteristic dummy, which is *NIGR* for the non-investment grade and non-rated convertibles, *NOTC* for issues traded on NASDAQ and/or OTC, *SCAP* for small cap firm issues, *NREP* for the issues that were underwritten by non-reputable investment bankers, *SSIZE* for issues with less than $50 million in offering proceeds. Parameter estimates are presented for two samples separately, with t-statistics in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

Estimates for models (16) and (17) are presented in Tables 10 and 11, respectively. Evidence of underpricing up to six months following issuance appears robust in both samples. Moreover, the cross-sectional pattern of results observed during the first five days following issuance persists over the first four weeks and the first six months but with increasingly greater statistical and economic significance. For example, significance of most coefficient estimates now holds at the 1 percent level.

Some new results however emerge in the weekly and monthly analysis. For example, the weekly analysis (Table 10) in relation to underwriter reputation ($Z = NREP$) shows that the coefficients of W_n are negative and significant. In particular, reputable underwriter issues are now underpriced from 0.54 to 0.87 percent in the first four weeks following issuance (previously insignificant in the five days following issuance), with non reputable underwriter issues seeing a further 1.71 to 2.13 percent discount. These results are intuitive and carry to the monthly analysis as well.

Table 10. Pricing Errors of Convertible Preferred Stock Panel Estimates with Convertible Characteristic and Weekly Dummies.

	Z=NIGR		*Z=NOTC*		*Z=SCAP*		*Z=NREP*		*Z=SSIZE*	
	Sample 1	*Sample 2*	*Sample 1*	*Sample 2*	*Sample 1*	*Sample 2*	*Sample 1*	*Sample 2*	*Sample 1*	*Sample 2*
Constant	N/A	0.0033	-0.0046	0.0033	-0.0046	0.0032	N/A	0.0033	-0.0046	0.0033
		(0.57)	(-0.63)	(0.57)	(-0.63)	(0.57)		(0.58)	(-0.64)	(0.57)
W1	N/A	-0.0210***	-0.0136***	-0.0188***	-0.0327***	-0.0341***	N/A	-0.0087***	-0.0321***	-0.0158***
		(-4.59)	(-3.19)	(-7.29)	(-4.97)	(-10.92)		(-3.19)	(-6.20)	(-6.65)
W2	N/A	-0.0205***	-0.0165***	-0.0177***	-0.0357***	-0.0346***	N/A	-0.0079***	-0.0340***	-0.0151***
		(-4.48)	(-3.87)	(-6.76)	(-5.43)	(-10.88)		(-2.86)	(-6.55)	(-6.29)
W3	N/A	-0.0208***	-0.0154***	-0.0154***	-0.0382***	-0.0314***	N/A	-0.0069**	-0.0329***	-0.0129***
		(-4.55)	(-3.62)	(-5.93)	(-5.80)	(-9.93)		(-2.53)	(-6.35)	(-5.40)
W4	N/A	-0.0192***	-0.0134***	-0.0136***	-0.0402***	-0.0299***	N/A	-0.0054**	-0.0314***	-0.0113***
		(-4.10)	(-3.15)	(-5.22)	(-6.11)	(-9.43)		(-1.98)	(-6.06)	(-4.71)
Z&W1	N/A	0.0044	N/A	0.0037	0.0327***	0.0296***	N/A	-0.0213***	0.0557***	-0.0072
		(0.85)		(0.84)	(3.80)	(7.09)		(-5.07)	(6.20)	(-1.47)
Z&W2	N/A	0.0053	N/A	0.0038	0.0330***	0.0323***	N/A	-0.0206***	0.0525***	-0.0053
		(1.02)		(0.86)	(3.83)	(7.63)		(-4.82)	(5.85)	(-1.07)
Z&W3	N/A	0.0088*	N/A	0.0045	0.0390***	0.0311***	N/A	-0.0171***	0.0526***	-0.0042
		(1.71)		(1.01)	(4.53)	(7.38)		(-4.02)	(5.86)	(-0.84)
Z&W4	N/A	0.0076	N/A	0.0015	0.0459***	0.0299***	N/A	-0.0194***	0.0540***	-0.0085*
		(1.45)		(0.34)	(5.33)	(7.06)		(-4.50)	(6.01)	(-1.67)

Panel-data analysis (random effect model) of pricing errors of convertible preferred stocks using equation:

$$ERROR_{i,t} = a + \sum_{n=1}^{n=4} b_n W_{n,t} + \sum_{n=1}^{n=4} b_{n+4} Z_i W_{n,t} + e_{i,t} \qquad (16)$$

where: the pricing error for issue i on date t is defined as $ERROR_{i,t} = \frac{(Market\ Price_{i,t} - Model\ Price_{i,t})}{Model\ Price_{i,t}}$, *W1-W4* are the first through fourth week trading dummies,

Z is a convertible characteristic dummy, which is *NIGR* for the non-investment grade and non-rated convertibles, *NOTC* for issues traded on NASDAQ and/or OTC, *SCAP* for small cap firm issues, *NREP* for the issues that were underwritten by non-reputable investment bankers, *SSIZE* for issues with less than $50 million in offering proceeds. Parameter estimates are presented for two samples separately, with t-statistics in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

For the monthly analysis (Table 11) in relation to exchange listing (*Z* = *NOTC*), the coefficient of $Z_i M_n$ are all positive and significant (previously insignificant for the five days and four weeks following issuance; see Tables 9 and 10, respectively). The results indicate that while NYSE/AMEX issues are underpriced 1.61 to 2.04 percent (similar to daily and weekly results), NASDAQ/OTC issues are overpriced relative to NYSE/AMEX issues by 0.56 to 1.11 percent. The counterintuitive result is the percentage underpricing of NASDAQ/OTC listed issues is less than that for issues listed on NYSE/AMEX.

A similar result seems to emerge in relation to investment rating (*Z* = *NIGR*). The coefficients of $Z_i M_n$ are positive with decreasing significance for the first 3 months following issuance (previously largely insignificant for the five days and four weeks following issuance). The results indicate that investment grades issues are underpriced from 1.49 to 2.43 percent (similar to daily and weekly results); but non investment grade issues are overpriced relative to investment grade issues by about 0.48 to 0.75 percent. The counterintuitive result again is that the percentage underpricing of non-investment-grades issues is less than that of their investment-grade counterparts.

Table 11. Pricing Errors of Convertible Preferred Stock Panel Estimates with Convertible Characteristic and Monthly Dummies.

	Z=NIGR		*Z=NOTC*		*Z=SCAP*		*Z=NREP*		*Z=SSIZE*	
	Sample 1	*Sample 2*	*Sample 1*	*Sample 2*	*Sample 1*	*Sample 2*	*Sample 1*	*Sample 2*	*Sample 1*	*Sample 2*
Constant	N/A	0.0063	-0.0003	0.0063	-0.0004	0.0064	N/A	0.0063	-0.0004	0.0063
		(1.10)	(-0.03)	(1.10)	(-0.05)	(1.12)		(1.11)	(-0.06)	(1.11)
M1	N/A	-0.0243***	-0.0190***	-0.0204***	-0.0452***	-0.0410***	N/A	-0.0095***	-0.0401***	-0.0167***
		(-10.44)	(-8.89)	(-15.47)	(-13.84)	(-26.28)		(-6.88)	(-15.65)	(-13.85)
M2	N/A	-0.0186***	-0.0287***	-0.0161***	-0.0514***	-0.0369***	N/A	-0.0068***	-0.0423***	-0.0126***
		(-7.84)	(-13.39)	(-11.98)	(-15.72)	(-23.19)		(-4.83)	(-16.52)	(-10.28)
M3	N/A	-0.0187***	-0.0254***	-0.0180***	-0.0478***	-0.0394***	N/A	-0.0089***	-0.0396***	-0.0135***
		(-7.84)	(-11.84)	(-13.40)	(-14.64)	(-24.48)		(-6.33)	(-15.46)	(-10.93)
M4	N/A	-0.0169***	-0.0160***	-0.0202***	-0.0349***	-0.0413***	N/A	-0.0119***	-0.0306***	-0.0149***
		(-7.13)	(-7.49)	(-15.18)	(-10.69)	(-26.01)		(-8.55)	(-11.96)	(-12.14)
M5	N/A	-0.0154***	-0.0143***	-0.0175***	-0.0356***	-0.0362***	N/A	-0.0115***	-0.0309***	-0.0134***
		(-6.65)	(-6.68)	(-13.13)	(-10.90)	(-22.96)		(-8.27)	(-12.07)	(-10.97)
M6	N/A	-0.0149***	-0.0139***	-0.0161***	-0.0295***	-0.0303***	N/A	-0.0114***	-0.0301***	-0.0124***
		(-6.38)	(-6.51)	(-11.98)	(-9.04)	(-18.88)		(-8.09)	(-11.77)	(-10.09)
Z&M1	N/A	0.0075***	N/A	0.0056**	0.0451***	0.0399***	N/A	-0.0217***	0.0636***	-0.0070***
		(2.87)		(2.54)	(10.52)	(19.17)		(-10.07)	(14.34)	(-2.79)
Z&M2	N/A	0.0063**	N/A	0.0070***	0.0391***	0.0412***	N/A	-0.0168***	0.0414***	-0.0045*
		(2.37)		(3.09)	(9.13)	(19.38)		(-7.63)	(9.33)	(-1.72)
Z&M3	N/A	0.0048*	N/A	0.0089***	0.0387***	0.0427***	N/A	-0.0146***	0.0432***	-0.0062**
		(1.79)		(3.89)	(9.04)	(20.06)		(-6.63)	(9.74)	(-2.40)
Z&M4	N/A	0.0006	N/A	0.0111***	0.0326***	0.0441***	N/A	-0.0113***	0.0442***	-0.0072***
		(0.21)		(4.85)	(7.60)	(20.76)		(-5.13)	(9.96)	(-2.74)
Z&M5	N/A	0.0021	N/A	0.0111***	0.0367***	0.0403***	N/A	-0.0056**	0.0504***	-0.0016
		(0.81)		(4.81)	(8.58)	(18.96)		(-2.50)	(11.35)	(-0.59)
Z&M6	N/A	0.0035	N/A	0.0111***	0.0269***	0.0316***	N/A	-0.0018	0.0491***	0.0010
		(1.32)		(4.90)	(6.29)	(14.83)		(-0.82)	(11.06)	(0.40)

Panel-data analysis (random effect model) of pricing errors of convertible preferred stocks using Equation (17): $ERROR_{i,t} = a + \sum_{n=1}^{n=6} b_n M_{n,i,t} + \sum_{n=1}^{n=6} b_{n+6} Z_i M_{n,t} + e_{i,t}$;

where: the pricing error for issue *i* on date *t* is defined as $ERROR_{i,t} = (Market\ Price_{i,t} - Model\ Price_{i,t}) / Model\ Price_{i,t}$, *M1-M6* are the first through sixth month trading dummies, *Z* is a convertible characteristic dummy, which is *NIGR* for the non-investment grade and non-rated convertibles, *NOTC* for issues traded on NASDAQ and/or OTC, *SCAP* for small cap firm issues, *NREP* for the issues that were underwritten by non-reputable investment bankers, *SSIZE* for issues with less than $50 million in offering proceeds. t-statistics are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

The mixed results in relation to issue size (*Z* = *SSIZE*) for the two samples continue to hold for the monthly analysis but are now accentuated. In particular, coefficients of $Z_i M_n$ are negative with varying degrees of significance for sample two in the first 4 months following issuance (previously largely insignificant for the five days and four weeks following issuance; see Tables 9 and 10, respectively). The results indicate that for sample one, mid/large size issues are underpriced about 3 to 4 percent while small size issued are overpriced relative to mid/large issues by about 4 to 6 percent. Conversely, for sample two, while mid/large size issue are underpriced 1.24 to 1.67 percent, small size issued are further underpriced 0.45 to 0.72 percent in the first four month following issuance. The latter result is more consistent with the intuition that smaller issues see greater pricing discounts.

Results of the cross-sectional analysis can be summarized as follows. Overall, there is strong evidence of underpricing for up to six months following issuance.

Further, there are three counterintuitive results affirmed to varying degrees. First, there is strong indication from both samples in the weekly and monthly analysis (and for sample two in the daily analysis) that mid and large cap issues are significantly underpriced with virtually no underpricing of small cap issues (*Z* = *SCAP*). Second, there is moderate indication from the monthly analysis of sample two that NYSE/AMEX listed issues are more largely underpriced than issues listed on NASDAQ/OTC; the weekly and daily analysis indicates underpricing is invariant to listing, which is still counterintuitive (*Z* = *NOTC*). Third, there is weak indication from the monthly analysis of sample two that investment grade issues are more largely underpriced than non-investment grade issues; the weekly and daily analysis indicates underpricing is invariant to investment rating, which is still a counterintuitive result (*Z* = *NIGR*).

In contrast, there are two intuitive results affirmed to varying degrees. First, there is strong indication from the weekly and monthly analysis (for sample two) that reputable underwriter issues are underpriced for six months following issuance; further the daily, weekly and monthly analysis indicates that non-reputable underwriter issues are underpriced even more (*Z* = *NREP*). Second, there is weak indication based on the monthly analysis of sample two that while mid/large size issues are underpriced for the first six month following issuance, small sized issued are underpriced even more for the first four months (*Z* = *SSIZE*). The daily and weekly analysis of sample two indicates underpricing is invariant to issue size.

While the daily, weekly and monthly analysis of sample one (corresponding to *Z* = *SSIZE*) also provide clear indication that mid/large size issue are underpriced for six months following issuance, small size issue may actually be overpriced during that same period. This is a mixed result I am unable to explain except that the two samples are drawn from distinct periods.

Empirical Analysis

Convertible Preferred Stock Performance Following Issuance

Holding Period Return Analysis

Table 12 presents means and medians of the convertibles' excess returns (*$ERET_i$*) and adjusted excess returns (*$ERETadj_i$*) for the fourteen periods examined. The mean and median of the first-day excess returns are not significantly different from zero.

One-tailed significance tests indicate excess-return means are significantly greater than zero (5% level) for first-week, one-month, three-month and four-month holding periods, and marginally greater than zero (10% level) for two-month and five-month holding periods. Mean values of adjusted excess return are significantly greater than zero (5% level) for first-week and one-month holding periods and marginally greater than zero (10% level) for two-month, three-month, four-month and five-month holding periods.

The Wilcoxon sign-rank test indicates that excess-return medians are significantly greater than zero for the first-week holding period and marginally greater than zero for one-month, two-month, three-month and four-month holding periods. Median values of adjusted excess return are significantly greater than zero for the first-week and one-month holding periods and marginally positive for two-month, three-month, four-month, eleven-month and twelve-month holding periods.

Mean excess returns are economically significant: 0.88% for the first week, 1.29% for the first month and 2.30% for the first five months. Interest-rate adjusted mean excess returns are also economically significant: 0.81% for the first week, 1.25% for the first month and 2.04% for the first five months. Excess returns hold notwithstanding the fact that the convertible has lower risk than the underlying common; risk-adjusted excess returns will naturally be higher.

These results further indicate that the convertibles' excess returns following issuance cannot be attributed solely to the higher betas of the underlying common.

Since convertibles provide downside protection (Lummer and Riepe, 1993; Golden Sachs, 2001) the positive excess returns are expected during the periods of negative returns of underlying common stocks. To make sure this is not the case, I examine the distribution of common returns over holding periods from one week to six months. Mean common returns are positive for all periods except for the three months holding period, which is negative but very small: 0.037%. Hence, the reported excess returns cannot be explained by downside protection of convertibles. Histograms of common and excess returns are presented in Figure 2 and Figure 3 respectively.

Also of interest to academics is the motive for issuing convertibles and inference of these motives via the common stock price reaction at issuance. For example, during the announcement period of convertible preferred stock, the underlying common displays negative abnormal returns (Linn and Pinegar, 1988). The underlying common also displays negative abnormal returns at both the announcement date and the issuance date for convertible debt (Dann and Mikkelson, 1984). In sample two, the common stock price reaction at issuance is neutral. Of the 69 offerings, 30 show positive returns, 30 show negative returns and 9 remain unchanged during the first trading day.

Table 12. Excess Returns of Convertible Preferreds over Corresponding Common Stock Returns.

Holding Period	*Excess Return*		*Adjusted Excess Return*	
	Mean	*Median*	*Mean*	*Median*
One Day	0.009 (0.565)	0.0148	0.009 (0.564)	0.147
One Week	0.0088** (2.142)	0.0045**	0.0081** (2.008)	0.0074**
One Month	0.0129** (1.876)	0.0048*	0.0125** (1.892)	0.0095**
Two Months	0.0167* (1.529)	0.0106*	0.0163* (1.496)	0.0090*
Three Months	0.0213** (1.694)	0.0098*	0.0203* (1.616)	0.0048*
Four Months	0.0229** (1.665)	0.0102*	0.0203* (1.471)	0.0149*
Five Months	0.0230* (1.577)	0.0137	0.0204* (1.403)	0.0131
Six Months	0.0106 (0.634)	-0.0020	0.0063 (0.382)	-0.0069
Seven Months	0.0143 (0.773)	-0.0173	0.0050 (0.272)	-0.0206
Eight Months	0.0121 (0.577)	0.0003	0.0025 (0.122)	-0.0070
Nine Months	-0.0055 (-0.234)	-0.0195	-0.0113 (-0.500)	-0.0247
Ten Months	-0.0086 (-0.412)	-0.0303	-0.0179 (-0.873)	-0.0312
Eleven Months	-0.0152 (-0.711)	-0.0319	-0.0226 (-1.070)	-0.0279*
Twelve Months	-0.0060 (-0.270)	-0.0420	-0.0164 (-0.752)	-0.0320*

Excess returns of convertible preferred stock are measured as the difference between convertible returns over underlying common returns for specific holding periods following issuance. Adjusted excess returns are the excess returns after controlling for changes in 30-year zero-coupon Treasury rates. First-day return is measured between the offer price and the first day of trading mid-spread closing price. The remaining returns are measured from first trading day mid-spread closing price and the last mid-spread closing price in the specified period. T-values are given in parentheses. Significance was assessed using T-test for means and Wilcoxon sign-rank test for medians. ** and * indicate that means and medians are significantly (one-tailed) higher or lower than zero at the 5% and 10% levels respectively.

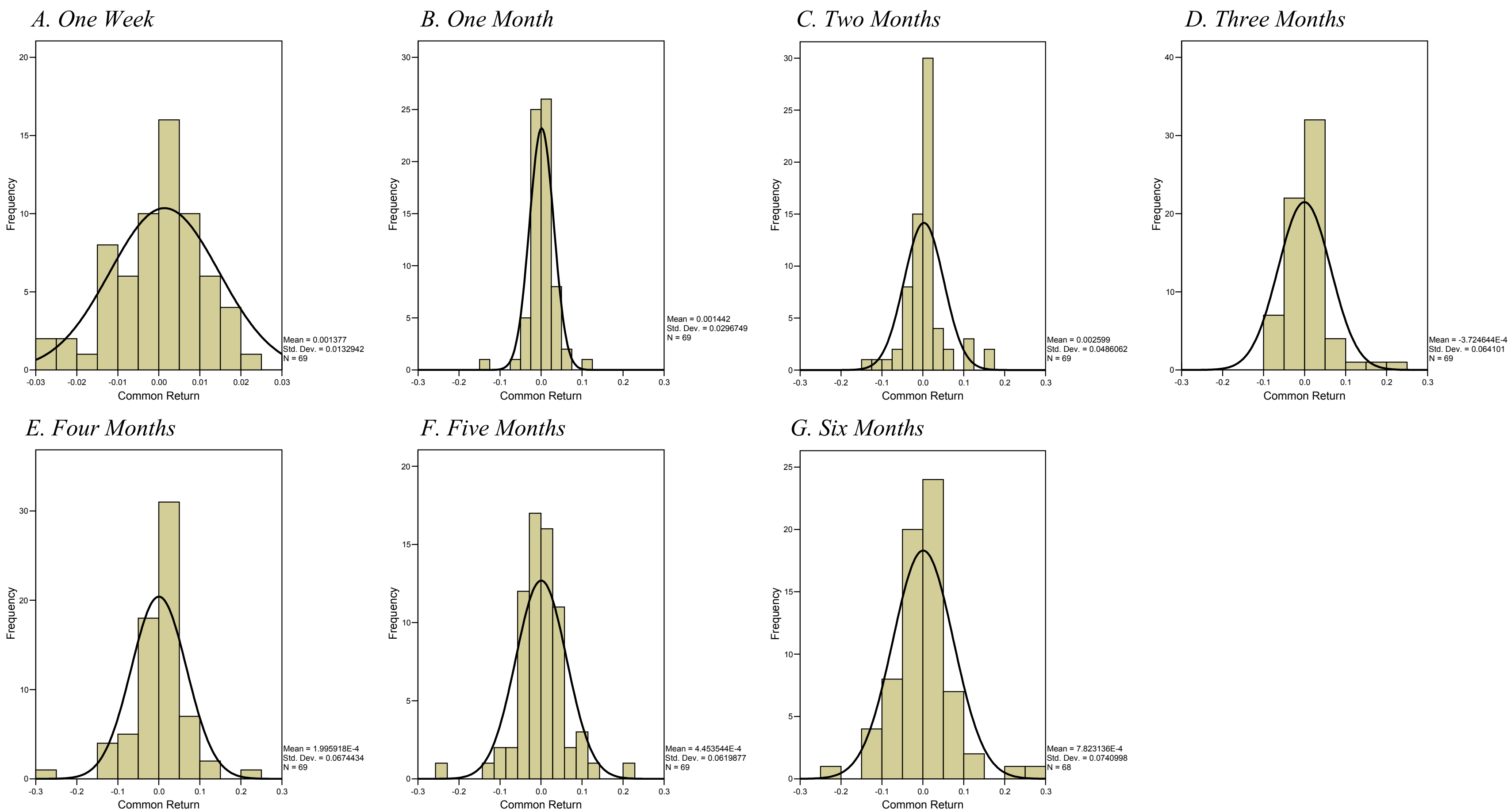


Figure 2. Frequency Distributions of Buy-and-Hold Common Stock Returns

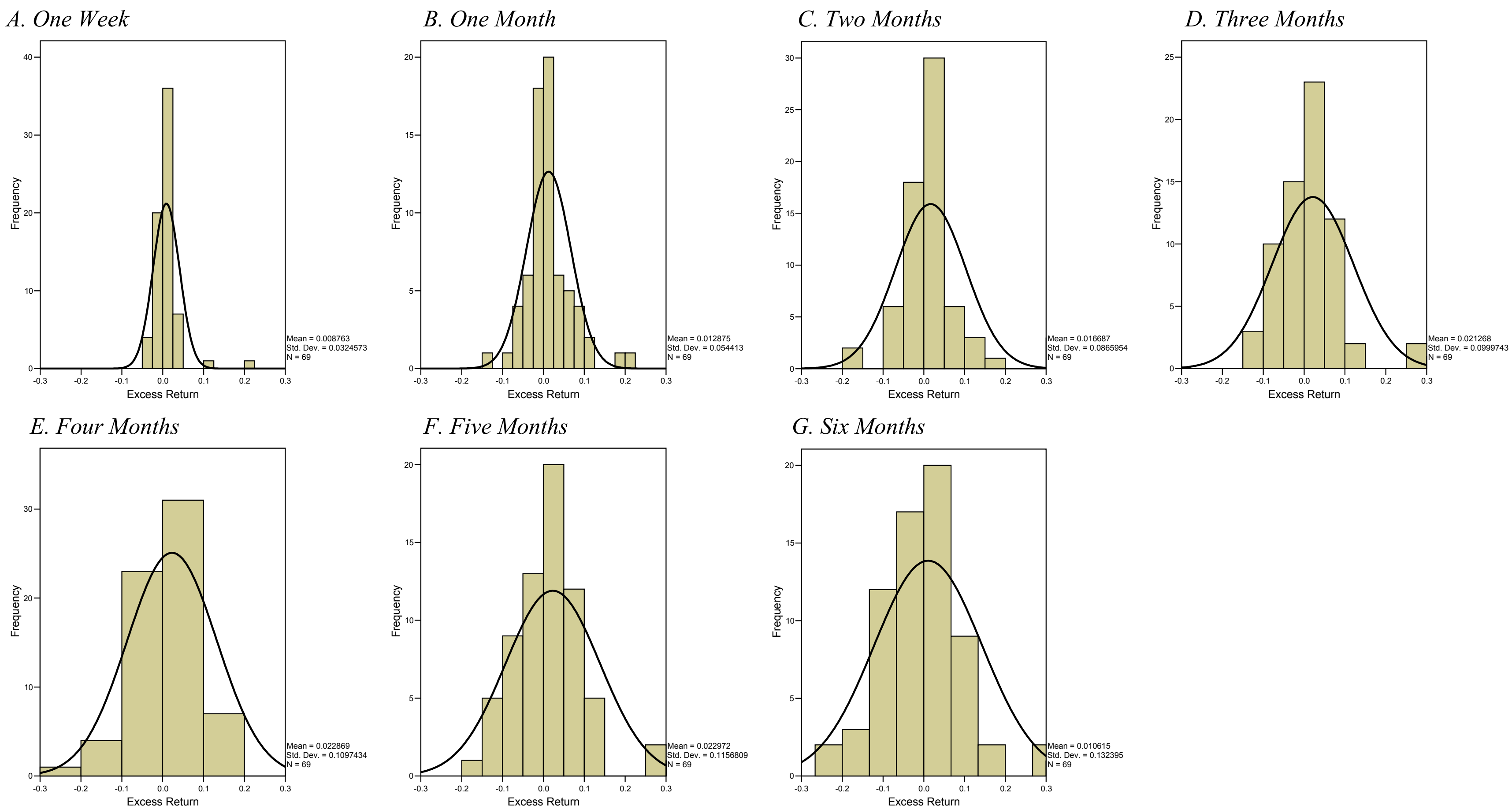


Figure 3. Frequency Distributions of Buy-and-Hold Excess Returns of Convertible Preferred Stocks over Underlying Common Stock Returns

Cross-Sectional Variations in Holding-Period Returns

Parameter estimates for (20) and (21) are presented in Table 13 for the first-day, one-week, and one-month to twelve-month holding-period returns (in monthly increments). Unexpectedly, NASDAQ/OTC traded convertibles exhibit lower excess returns (marginally significant at the 10% level) during the first week and first month following issuance compared to NYSE/AMEX issues. Small-size issues on the other hand exhibit larger excess returns (marginally significant at the 10% level) during the first week following issuance compared to mid-size and large-size issues. Non-reputable underwriter issues exhibit superior returns in longer holding periods from 6 to 12 months. In large part, excess returns observed during the first five months following issuance are invariant to the chosen factors, similar to findings by Kang and Lee (1996) for convertible bonds.

Table 13. Excess Returns of Convertible Preferred Stocks over Corresponding Common Stock – Cross-sectional variation – OLS estimates

Holding Period	*Model*	*Const.*	*NIGR*	*NOTC*	*SCAP*	*NREP*	*SSIZE*	*Adj* R^2
First Day	*ERET*	0.0146	-0.0011	0.0216	0.0177	-0.0526	-0.0018	-0.06
		(0.38)	(-0.02)	(0.47)	(0.43)	(-1.05)	(-0.04)	
	ERET adj.	0.0165	-0.0060	0.0233	0.0078	-0.0514	0.0051	-0.06
		(0.40)	(-0.12)	(0.46)	(0.17)	(-0.95)	(0.09)	
One Week	*ERET*	0.0067	0.0025	-0.0206*	-0.0016	0.0054	0.0238*	0.02
		(0.71)	(0.23)	(-1.81)	(-0.15)	(0.44)	(1.92)	
	ERET adj.	0.0047	0.0076	-0.0202	0.0214	0.0019	0.0091	-0.07
		(0.14)	(0.19)	(-0.50)	(0.60)	(0.04)	(0.21)	
One Month	*ERET*	0.0161	-0.0003	-0.0330*	0.0065	0.0136	-0.0021	-0.03
		(0.99)	(-0.02)	(-1.67)	(0.37)	(0.64)	(-0.10)	
	ERET adj.	0.0176	-0.0051	-0.0345*	0.0103	0.0148	-0.0028	-0.02
		(1.13)	(-0.28)	(-1.83)	(0.61)	(0.73)	(-0.13)	
Two Months	*ERET*	-0.0178	0.0373	-0.0198	0.0035	0.0368	-0.0114	-0.01
		(-0.72)	(1.27)	(-0.66)	(0.13)	(1.14)	(-0.35)	
	ERET adj.	-0.0151	0.0328	-0.0205	0.0034	0.0398	-0.0137	-0.01
		(-0.61)	(1.12)	(-0.68)	(0.13)	(1.23)	(-0.42)	
Three Months	*ERET*	-0.0185	0.0308	-0.0111	0.0105	0.0473	-0.0268	-0.01
		(-0.63)	(0.88)	(-0.31)	(0.33)	(1.23)	(-0.69)	
	ERET adj.	-0.0179	0.0297	-0.0127	0.0101	0.0487	-0.0294	-0.02
		(-0.60)	(0.85)	(-0.35)	(0.31)	(1.27)	(-0.76)	
Four Months	*ERET*	-0.0171	0.0224	-0.0350	0.0320	0.0580	-0.0318	0.03
		(-0.53)	(0.59)	(-0.89)	(0.91)	(1.38)	(-0.74)	
	ERET adj.	-0.0187	0.0221	-0.0375	0.0341	0.0575	-0.0338	0.04
		(-0.58)	(0.58)	(-0.96)	(0.97)	(1.36)	(-0.79)	
Five Months	*ERET*	-0.0014	0.0068	-0.0169	0.0134	0.0624	-0.0356	-0.03
		(-0.04)	(0.17)	(-0.41)	(0.36)	(1.39)	(-0.79)	
	ERET adj.	-0.0050	0.0061	-0.0203	0.0188	0.0628	-0.0373	-0.03
		(-0.15)	(0.15)	(-0.49)	(0.51)	(1.41)	(-0.83)	
Six Months	*ERET*	-0.0302	0.0151	-0.0194	0.0109	0.1010**	-0.0514	0.02
		(-0.78)	(0.33)	(-0.42)	(0.26)	(2.01)	(-1.02)	
	ERET adj.	-0.0324	0.0132	-0.0247	0.0147	0.1032**	-0.0587	0.02
		(-0.85)	(0.29)	(-0.54)	(0.36)	(2.08)	(-1.17)	
Seven Months	*ERET*	-0.0159	-0.0151	-0.0297	0.0285	0.0990*	-0.0207	0.01
		(-0.37)	(-0.30)	(-0.57)	(0.61)	(1.77)	(-0.37)	
	ERET adj.	-0.0236	-0.0177	-0.0327	0.0362	0.0973*	-0.0290	0.01
		(-0.56)	(-0.35)	(-0.64)	(0.79)	(1.77)	(-0.52)	
Eight Months	*ERET*	-0.0232	-0.0109	-0.0120	0.0297	0.1041*	-0.0501	-0.01
		(-0.47)	(-0.19)	(-0.20)	(0.56)	(1.74)	(-0.78)	
	ERET adj.	-0.0319	-0.0136	-0.0214	0.0338	0.1111*	-0.0523	0.01
		(-0.67)	(-0.24)	(-0.37)	(0.65)	(1.78)	(-0.83	
Nine Months	*ERET*	-0.0323	-0.0343	-0.0137	0.0380	0.1277*	-0.0650	0.02
		(-0.61)	(-0.55)	(-0.22)	(0.67)	(1.87)	(-0.94)	
	ERET adj.	-0.0349	-0.0383	-0.0241	0.0416	0.1303*	-0.0625	0.02
		(-0.67)	(-0.62)	(-0.38)	(0.74)	(1.92)	(-0.91)	
Ten Months	*ERET*	-0.0473	-0.0329	0.0053	0.0340	0.1516**	-0.0805	0.09
		(-1.02)	(-0.60)	(0.10)	(0.68)	(2.51)	(-1.32)	
	ERET adj.	-0.0535	-0.0366	-0.0086	0.0391	0.1539**	-0.0764	0.09
		(-1.17)	(-0.68)	(-0.16)	(0.79)	(2.59)	(-1.27)	

Holding Period	Model	Const.	NIGR	NOTC	SCAP	NREP	SSIZE	Adj R^2
Eleven Months	*ERET*	-0.0454	-0.0389	-0.0256	0.0208	0.177***	-0.0635	0.1
		(-0.96)	(-0.70)	(-0.45)	(0.40)	(2.87)	(-1.02)	
	ERET adj.	-0.0505	-0.0387	-0.0369	0.0215	0.180***	-0.0636	0.1
		(-1.08)	(-0.70)	(-0.65)	(0.42)	(2.97)	(-1.04)	
Twelve Months	*ERET*	-0.0369	-0.0240	-0.0538	0.0085	0.207***	-0.0883	0.1
		(-0.75)	(-0.42)	(-0.91)	(0.16)	(3.24)	(-1.37)	
	ERET adj.	-0.0442	-0.0225	-0.0693	0.0086	0.208***	-0.0851	0.1
		(-0.92)	(-0.40)	(-1.19)	(0.17)	(3.31)	(-1.35)	

Cross sectional regressions of cumulative percentage returns using equations:

$$ERET_i = a + b_1 NIGR_i + b_2 NOTC_i + b_3 SCAP_i + b_4 NREP_i + b_5 SSIZE_i + e_i \quad (20)$$

$$ERETadj_i = a + b_1 NIGR_i + b_2 NOTC_i + b_3 SCAP_i + b_4 NREP_i + b_5 SSIZE_i + e_i \quad (21)$$

where: *ERET* is the excess returns of convertible preferred stocks over corresponding common stock calculated as $CVR - COMR$, *ERETadj* is the excess returns after controlling for interest rate change, *CVR* is the cumulative returns of convertibles for corresponding time period, *COMR* is the cumulative returns of underlying common stocks for corresponding time period, *NIGR* is the non-investment grade or non-rated convertible dummy, *NOTC* indicates issues traded on NASDAQ and/or OTC, *SCAP* is the small cap firm dummy, *NREP* denotes the issues that were underwritten by non-reputable investment bankers, *SSIZE* indicates the issues with less than $50 million in offering proceeds. Parameter estimates are presented, with t-statistics in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

Estimates of (22) and (23) are presented in Table 14 for the first-day, one-week, and one-month to twelve-month holding-period returns (in monthly increments). Significant coefficients of interest rates and common stock returns have expected signs: negative for interest rates and positive for common stock returns. The coefficient of common stock returns is surprisingly high: increasing to more than 2 for one- to six-month holding periods, thereafter decreasing to 1.26 for the twelve-month holding period. This is consistent with our belief that excess returns in the early months following issuance is associated with increased sensitivity of the convertible to the underlying common. The finding suggests convertibles display higher "systematic risk" in the early months following issuance dropping to lower levels by the end of the first year.

In contrast, impact of the five chosen factors (*NIGR, NOTC, SCAP, NREP and SSIZE*) on convertible returns as well as on the sensitivity of convertible returns to the underlying common stock remains elusive. For example, convertible returns are unaffected by investment ratings (*NIGR*) and firm size (*SCAP*) for all holding periods up to 12 months. Underwriter reputation (*NREP*) also has no significant impact on convertible returns for holding periods up to 9 months following issuance. Counter intuitively, issues traded on NASDAQ and OTC (*NOTC*) offer significant negative returns for one-week and one-month holding periods. Small-size issues however offer significant positive returns for the first week and up to three-month holding periods.

Impact of the chosen factors on the sensitivity of convertible returns to the underlying common stock is more insightful. For example, small firm issues display increased sensitivity to the underlying common (*SCAP&COMR*) for one- four- and five-month holding periods and non-reputable underwriter issues (*NREP&COMR*) for three- and four-month holding periods albeit with marginal significance. NASDAQ and OTC issues display increased sensitivity to the underlying common stock (*NOTC&COMR*) for one- and two-month holding periods although this is reversed for five- and eight-month holding periods. Small size issues also display increased sensitivity to the common (*SSIZE&COMR*) for five-month holding periods but this is also reversed for most periods exceeding five months. In contrast, non-investment rated issues display decreased sensitivity (*NIGR&COMR* coefficients are negative and marginally significant) to the underlying common stock for three-, four- and five-month holding periods.

The analysis indicates some evidence that cross-sectional variation of convertible returns in the early months following issuance is impacted by increased sensitivity of the convertible to the underlying common although the evidence is mixed at best.

Table 14. Cumulative Returns of Convertible Preferred Stock Regression Estimates

Holding Period	*Eq.*	*Const.*	*RATE*	*COMR*	*NIGR*	*NIGR & COMR*	*NOTC*	*NOTC & COMR*	*SCAP*	*SCAP & COMR*	*NREP*	*NREP & COMR*	*SSIZE*	*SSIZE & COMR*	*Adj* R^2
First	22	0.0163	-0.0974	-0.3995	-0.0004		0.0265		0.0074		-0.0412		-0.0021		-0.1
Day		(0.44)	(-0.31)	(-0.67)	(-0.01)		(0.59)		(0.18)		(-0.85)		(-0.04)		
	23	0.0133	-0.1334	2.0722	0.0129	-1.5413	0.0436	-3.0849	-0.0007	1.1267	-0.0413	-1.2694	-0.0209	1.5315	-0.1
		(0.35)	(-0.41)	(0.82)	(0.29)	(-0.58)	(0.88)	(-1.31)	(-0.02)	(0.50)	(-0.75)	(-0.70)	(-0.40)	(0.72)	
One	22	0.0057	-0.0463	1.46***	0.0017		-0.022**		-0.0003		0.0059		0.025**		0.29
Week		(0.61)	(-1.12)	(4.71)	(0.15)		(-1.96)		(-0.02)		(0.49)		(2.06)		
	23	0.0023	-0.0442	2.68***	0.0037	-0.7198	-0.0213*	-0.7815	0.0002	-0.6440	0.0078	0.6288	0.025*	-0.3523	0.41
		(0.24)	(-1.02)	(2.53)	(0.32)	(-0.64)	(-1.85)	(-0.92)	(0.02)	(-0.79)	(0.60)	(0.54)	(1.96)	(-0.27)	
One	22	0.0141	-0.0548*	1.93***	-0.0043		-0.037**		0.0122		0.0037		0.0221		0.61
Month		(1.03)	(-1.95)	(9.36)	(-0.27)		(-2.26)		(0.83)		(0.21)		(1.17)		
	23	0.0140	-0.051**	2.300**	-0.0060	-1.2717	-0.038**	1.053**	0.0126	1.023**	-0.0071	0.4704	0.05***	-0.2984	0.72
		(1.10)	(-2.09)	(2.31)	(-0.41)	(-1.26)	(-2.57)	(2.27)	(0.97)	(1.99)	(-0.44)	(0.82)	(2.70)	(-0.44)	
Two	22	-0.002	-0.0146	2.32***	0.0085		-0.0250		0.0213		-0.0075		0.0392*		0.77
Months		(-0.11)	(-0.60)	(14.16)	(0.40)		(-1.19)		(1.13)		(-0.32)		(1.72)		
	23	0.0017	-0.0022	2.61***	0.0012	-0.7473	-0.0309	0.761**	0.0255	0.3749	-0.0200	0.4695	0.057**	-0.7283	0.79
		(0.10)	(-0.09)	(5.60)	(0.05)	(-1.45)	(-1.33)	(2.01)	(1.35)	(0.70)	(-0.79)	(0.91)	(2.31)	(-1.11)	
Three	22	-0.004	-0.0223	1.82***	0.0232		-0.0264		0.0094		0.0177		0.0139		0.63
Months		(-0.17)	(-0.72)	(10.09)	(0.76)		(-0.83)		(0.33)		(0.51)		(0.39)		
	23	0.0056	-0.0102	2.62***	0.0005	-1.397**	-0.0214	0.7452	0.0128	0.4317	-0.0164	1.0957*	0.0616*	0.1081	0.73
		(0.24)	(-0.37)	(4.11)	(0.02)	(-2.10)	(-0.67)	(1.52)	(0.52)	(0.76)	(-0.51)	(1.75)	(1.90)	(0.16)	
Four	22	-0.010	-0.0167	2.00***	0.0243		-0.0320		0.0261		0.0121		0.0126		0.70
Months		(-0.39)	(-0.69)	(11.76)	(0.79)		(-1.01)		(0.92)		(0.35)		(0.35)		
	23	-0.010	0.0014	2.63***	0.0237	-1.242**	0.0355	-1.1589	0.0180	0.7361*	-0.0448	1.164**	0.0218	0.6613	0.78
		(-0.45)	(0.06)	(5.26)	(0.88)	(-2.33)	(1.00)	(-1.60)	(0.74)	(1.76)	(-1.36)	(2.44)	(0.65)	(0.91)	
Five	22	-0.005	-0.0289	2.15***	0.0154		0.0028		0.0105		0.0063		0.0131		0.65
Months		(-0.19)	(-1.23)	(10.70)	(0.46)		(0.08)		(0.34)		(0.17)		(0.34)		
	23	-0.005	-0.0114	2.58***	0.0045	-1.153*	0.0461	-1.81***	0.0201	1.223**	-0.0277	0.6699	0.0171	1.66***	0.80
		(-0.24)	(-0.62)	(4.26)	(0.17)	(-1.78)	(1.63)	(-3.99)	(0.84)	(2.51)	(-0.89)	(1.26)	(0.56)	(2.94)	
Six	22	-0.021	-0.0042	2.07***	0.0206		0.0367		0.0039		0.0214		-0.0431		0.66
Months		(-0.64)	(-0.15)	(10.13)	(0.54)		(0.90)		(0.11)		(0.48)		(-1.00)		
	23	-0.013	-0.0050	2.23***	-0.0015	-0.6715	0.0259	-0.0599	0.0200	0.7398	-0.0074	0.8326	-0.0050	-1.58***	0.70
		(-0.41)	(-0.18)	(3.66)	(-0.04)	(-1.02)	(0.62)	(-0.11)	(0.58)	(1.28)	(-0.17)	(1.25)	(-0.12)	(-3.01)	

Holding Period	*Eq.*	*Const.*	*RATE*	*COMR*	*NIGR*	*NIGR & COMR*	*NOTC*	*NOTC & COMR*	*SCAP*	*SCAP & COMR*	*NREP*	*NREP & COMR*	*SSIZE*	*SSIZE & COMR*	*Adj* R^2
Seven	22	-0.010	-0.0332	1.57***	-0.0231		0.0118		0.0194		0.0647		-0.0242		0.50
Months		(-0.23)	(-1.09)	(7.26)	(-0.48)		(0.23)		(0.43)		(1.19)		(-0.45)		
	23	-0.024	-0.0515*	0.5766	-0.0053	1.5098	0.0121	-0.0254	0.0008	0.4176	0.0332	0.6234	0.0133	-2.23***	0.63
		(-0.59)	(-1.86)	(0.64)	(-0.11)	(1.55)	(0.26)	(-0.06)	(0.02)	(0.63)	(0.69)	(0.88)	(0.27)	(-4.29)	
Eight	22	-0.011	-0.0484*	1.99***	-0.0235		0.0292		0.0254		0.0556		-0.0412		0.54
Months		(-0.26)	(-1.70)	(8.27)	(-0.46)		(0.54)		(0.55)		(0.96)		(-0.73)		
	23	-0.020	-0.0393	1.2339	-0.0069	1.1659	0.0480	-1.0985*	0.0098	0.4316	0.0311	0.1493	-0.0456	-0.8107	0.58
		(-0.44)	(-1.39)	(1.48)	(-0.13)	(1.27)	(0.89)	(-1.78)	(0.21)	(0.59)	(0.55)	(0.19)	(-0.82)	(-1.24)	
Nine	22	-0.009	-0.0371	2.04***	-0.0534		0.0224		0.0354		0.0684		-0.0479		0.52
Months		(-0.18)	(-1.22)	(7.94)	(-0.96)		(0.38)		(0.70)		(1.09)		(-0.78)		
	23	-0.014	-0.0287	1.5581	-0.0394	0.8209	0.0291	-0.7101	0.0303	0.6053	0.0491	-0.2191	-0.0501	-0.7087	0.52
		(-0.25)	(-0.91)	(1.33)	(-0.60)	(0.66)	(0.47)	(-1.13)	(0.58)	(0.74)	(0.75)	(-0.24)	(-0.78)	(-0.98)	
Ten	22	-0.032	-0.0396	1.63***	-0.0464		0.0268		0.0347		0.1032*		-0.0701		0.53
Months		(-0.71)	(-1.42)	(7.13)	(-0.90)		(0.48)		(0.73)		(1.73)		(-1.22)		
	23	-0.039	-0.0338	1.2271	-0.0211	1.1247	0.0317	-0.6041	0.0314	0.3241	0.0647	-0.0739	-0.0596	-1.228**	0.57
		(-0.64)	(-1.19)	(0.99)	(-0.31)	(0.86)	(0.57)	(-1.20)	(0.67)	(0.41)	(1.10)	(-0.08)	(-1.04)	(-2.17)	
Eleven	22	-0.023	-0.0302	1.76***	-0.0473		0.0111		0.0164		0.121**		-0.0677		0.55
Months		(-0.52)	(-1.16)	(7.54)	(-0.92)		(0.20)		(0.35)		(2.03)		(-1.18)		
	23	-0.029	-0.0284	1.3926	-0.0252	0.9830	0.0178	-0.4282	0.0209	0.4977	0.0823	-0.3301	-0.0599	-1.0763*	0.58
		(-0.49)	(-1.05)	(1.31)	(-0.37)	(0.85)	(0.31)	(-0.86)	(0.41)	(0.57)	(1.37)	(-0.35)	(-1.04)	(-1.86)	
Twelve	22	-0.036	-0.0313	1.26***	-0.0241		-0.0376		0.0049		0.18***		-0.0936		0.57
Months		(-0.73)	(-1.11)	(6.93)	(-0.42)		(-0.58)		(0.09)		(2.67)		(-1.47)		
	23	-0.023	-0.0424*	1.4851	-0.0116	0.8768	-0.0302	0.0312	0.0123	0.3305	0.0926	-0.0593	-0.0413	-1.83***	0.70
		(-0.44)	(-1.73)	(1.51)	(-0.20)	(0.92)	(-0.54)	(0.09)	(0.27)	(0.49)	(1.61)	(-0.08)	(-0.74)	(-4.39)	

Cross sectional regressions (OLS) of cumulative percentage returns using equations:

$$CVR_i = a + b_1 RATE_i + b_2 COMR_i + b_3 NIGR_i + b_4 NOTC_i + b_5 SCAP_i + b_6 NREP_i + b_7 SSIZE_i + e_i \tag{22}$$

$$\begin{aligned} CVR_i = {} & a + b_1 RATE_i + b_2 COMR_i + b_3 NIGR_i + b_4 (NIGR_i \times COMR_i) + b_5 NOTC_i + b_6 (NOTC_i \times COMR_i) + b_7 SCAP_i \\ & + b_8 (SCAP_i \times COMR_i) + b_9 NREP_i + b_{10} (NREP_i \times COMR_i) + b_{11} SSIZE_i + b_{12} (SSIZE_i \times COMR_i) + e_i \end{aligned} \tag{23}$$

where *CVR* is the cumulative returns of convertibles for corresponding time period, *RATE* is the change in zero-coupon 30-year Treasure rates over the same period of time, *COMR* is the cumulative returns of underlying common stocks for corresponding time period, *NIGR* is the non-investment grade or non-rated convertible dummy, *NOTC* indicates issues traded on NASDAQ and/or OTC, *SCAP* is the small cap firm dummy, *NREP* denotes the issues that were underwritten by non-reputable investment bankers, *SSIZE* indicates the issues with less than $50 million in offering proceeds. Parameter estimates are presented, with t-statistics in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

Panel-Data Analysis of Daily, Weekly and Monthly Convertible Returns

Following standard econometric practice, I use the F-test, and the Hausman and Lagrange Multiplier tests for unobserved heterogeneity, and then select the appropriate type of panel-data analysis. Due to unobserved heterogeneity in the sample and the presence of time-invariant dummy variables, I utilize the random effect model.

Analysis of Daily, Weekly and Monthly Returns in Early Periods Following Issuance

Parameter estimates for models (24), (25) and (26) are presented in Table 15. All coefficients are multiplied by 100 for convenience. Coefficients of common stock returns are positive and significant as expected for all three models. Surprisingly, the coefficients of interest-rate changes are also positive and significant. On further analysis, I find that the simple correlation coefficients between interest-rate changes, common returns and convertibles returns are all positive for the two-year estimation period using daily returns. For weekly and monthly returns, the correlation coefficients are still positive although the relative size of the correlation between interest-rate changes and convertible returns decreases for increasingly larger return periods. Apparently, for shorter periods, the convertible's call option on the underlying firm is manifested; accordingly, we observe the positive dependence of this call option on interest-rate changes.

I discuss later that with increased refinement of the model together with larger (monthly) return periods, the negative relation between interest-rate changes and convertible returns reemerges. In summary, over shorter return periods convertibles display largely equity characteristics; fixed-income characteristics re-emerge for longer periods but even then it is weak at best.

The time dummy coefficients are significant only for the fifth day, first week and first month of trading following issuance. The coefficient of the fifth-day dummy suggests that convertibles realize a 0.5 percent excess return on that trading day after controlling for interest-rates changes and common-stock returns. The average daily excess return during the first week is 0.22 percent and 0.09 percent for the first month, suggesting total excess returns of 1.1 percent (1.8 percent) for the first week (month).

The more interesting results are conveyed by the interaction-term coefficients. In particular, convertibles are significantly more sensitive (at the 1 percent level) to the performance of their underlying common stock in each of the first six months of trading following issuance relative to the remaining months up to 2 years. All weekly interaction-term coefficients are also positive and significant. These results affirm my earlier findings in relation to holding-period returns in Section 3.1 that excess returns of convertibles as an asset class in the months immediately following issuance arises primarily from increased sensitivity of the convertible to the underlying common.

The preceding analysis is repeated for weekly and monthly returns to yield largely similar results. Thus the results are robust to the return-measurement period.

Table 15. Convertible Preferred Stock Daily Returns Panel Estimates

Model (24)	*Const*	*RATE*	*CORD*	*D2*	*D3*	*D4*	*D5*	*D2 & CORD*	*D3 & CORD*	*D4 & CORD*	*D5 & CORD*
A	0.008	103.9***	22.1***	0.225	-0.007	0.195	0.455**				
	(0.59)	(5.34)	(72.27)	(1.10)	(-0.03)	(0.93)	(2.16)				
B	0.008	104.3***	22.1***	0.198	-0.021	0.166	0.454**	5.516	12.032	23.9***	-3.571
	(0.57)	(5.36)	(71.97)	(0.95)	(-0.10)	(0.79)	(2.16)	(0.76)	(0.78)	(3.04)	(-0.32)

Model (25)	*Const*	*RATE*	*CORD*	*W1*	*W2*	*W3*	*W4*	*W1 & CORD*	*W2 & CORD*	*W3 & CORD*	*W4 & CORD*
A	0.006	103.8***	22.1***	0.218**	0.067	0.043	0.050				
	(0.44)	(5.33)	(72.26)	(2.09)	(0.71)	(0.45)	(0.52)				
B	0.006	104.6***	21.9***	0.199*	0.040	0.067	0.046	10.79**	10.12**	26.2***	17.2***
	(0.43)	(5.38)	(70.88)	(1.90)	(0.41)	(0.69)	(0.48)	(2.36)	(2.17)	(5.27)	(3.56)

Model (26)	*Const*	*RATE*	*CORD*	*M1*	*M2*	*M3*	*M4*	*M5*	*M6*	*M1 & CORD*	*M2 & CORD*	*M3 & CORD*	*M4 & CORD*	*M5 & CORD*	*M6 & CORD*
A	0.006	103.7***	22.1***	0.090*	0.015	0.039	0.026	-0.019	-0.066						
	(0.42)	(5.33)	(72.24)	(1.79)	(0.29)	(0.78)	(0.51)	(-0.37)	(-1.29)						
B	0.006	101.3***	19.7***	0.075	0.013	0.013	0.022	-0.016	-0.038	17.9***	18.1***	20.1***	23.1***	13.1***	21.5***
	(0.42)	(5.25)	(60.28)	(1.50)	(0.26)	(0.26)	(0.44)	(-0.32)	(-0.74)	(7.57)	(8.74)	(9.65)	(10.13)	(7.39)	10.90)

Panel-data analysis (random effect model) of daily returns of convertible preferred stocks using Equations 24, 25, and 26:

A. $$CVRD_i = a + b_1 RATE_i + b_2 CORD_i + \sum_{n=2}^{n=5} b_{n+1} D_n + e_i$$
B. $$CVRD_i = a + b_1 RATE_i + b_2 CORD_i + \sum_{n=2}^{n=5} b_{n+1} D_n + \sum_{n=2}^{n=5} b_{n+5} D_n CORD_i + e_i \quad (24)$$

A. $$CVRD_i = a + b_1 RATE_i + b_2 CORD_i + \sum_{n=1}^{n=4} b_{n+2} W_n + e_i$$
B. $$CVRD_i = a + b_1 RATE_i + b_2 CORD_i + \sum_{n=1}^{n=4} b_{n+2} W_n + \sum_{n=1}^{n=4} b_{n+6} W_n CORD_i + e_i \quad (25)$$

A. $$CVRD_i = a + b_1 RATE_i + b_2 CORD_i + \sum_{n=1}^{n=6} b_{n+2} M_n + e_i$$
B. $$CVRD_i = a + b_1 RATE_i + b_2 CORD_i + \sum_{n=1}^{n=6} b_{n+2} M_n + \sum_{n=1}^{n=6} b_{n+8} M_n CORD_i + e_i \quad (26)$$

where: *CVRD* is the convertible daily returns measured from closing to closing using mid-spread prices, *CORD* is the underlying common stock daily returns measured from closing to closing using mid-spread prices, *RATE* is the daily change in the estimated zero-coupon 30-year Treasure rates, *D2-D5* are the second through fifth day of trading dummies, *W1-W4* are the first through fourth week trading dummies, and *M1-M6* are the first through sixth month trading dummies. Parameter estimates are presented, with t-statistics in parentheses. All coefficients are multiplied by 100. *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

Cross-Sectional Analysis of Daily, Weekly, and Monthly Returns Following Issuance

Parameter estimates for (27) are presented in Table 16. Again, all coefficients are multiplied by 100 for convenience. Coefficients of common stock returns are positive and significant as expected for all versions of the model (corresponding to the five different characteristic dummies Z_i). The coefficients of interest-rate changes are also positive and significant as previously noted. When model 27 is re-estimated using weekly and monthly returns the results are largely similar to those reported here except that the coefficient of *RATE* becomes smaller and changes sign for larger return periods).

All coefficients of monthly dummies (M_n) and virtually all coefficients of the interaction terms ($Z_i M_n$) are insignificant: there is no evidence of daily excess returns in the six months following issuance which cannot be explained by increased sensitivity of the convertible to the underlying common regardless of the security's characteristics.

In stark contrast, all coefficients of $M_n CORD_i$ are economically and statistically significant as are virtually all coefficients of $Z_i M_n CORD_i$. To see what this means, examine the case *Z=NIGR* in Table 7. The coefficient of *CORD* is 19.651, the coefficient of *M1&CORD* is 31.720 and that of *Z&M1&CORD* is -15.682. It means the average sensitivity of daily returns of convertible securities to their underlying common in months 7 to 24 following issuance is <u>19.651;</u> the sensitivity rises to <u>51.371</u> (19.651+31.720) during the first month following issuance for investment grade issues, dropping to <u>35.689</u> (51.371-15.682) during the first month for non-investment grade issues. For the first six months, the average sensitivity of convertibles to the underlying common is about 50 (for investment grade issues) and 37 (for non-investment grade issues) compared to about 20 for all issues beyond the six-month period up to two years.

These results are dramatic: on average, investment grade issues are 2.5 times more sensitive to the underlying common stock in the first six months after issuance compared to the following 18-month benchmark period; and non-investment grade issues are 1.9 times more sensitive during the same period relative to the benchmark.

Corresponding ratios are (2.7 and 1.2) for NYSE/AMEX versus NASDAQ/OTC; (2.5 and 1.5) for large/mid versus small cap firms; (2.5 and 1.3) for reputable versus non-reputable underwriters; and (2.5 and 0.8) for large/mid versus small size issues. Only small size issues display less sensitivity to the underlying common in the first six months following issuance relative to the following 18-month benchmark period.

The relative size of each pair of ratios is counterintuitive: investment grade, NYSE/AMEX, large/mid cap, reputable underwriter, and large/mid size issues are all more sensitive to their underlying common, i.e. they have higher "systematic risk" relative to their counterparts in the first six months following issuance.

Apparently, excess returns owing to this higher "systematic risk" offset excess returns to the counterpart securities owing to their "inferior" Z_i characteristics such that no cross-sectional variation is observed other than which is explained by increased sensitivity of the convertible to the underlying common during the first six months.

Table 16. Convertible Preferred Stock Daily Returns Panel Estimates

	Z=NIGR	*Z=NOTC*	*Z=SCAP*	*Z=NREP*	*Z=SSIZE*
Constant	0.032	0.016	0.016	0.005	0.004
	(1.02)	(0.87)	(0.71)	(0.26)	(0.25)
RATE	98.766***	97.003***	98.629***	100.30***	100.122***
	(5.12)	(5.06)	(5.13)	(5.22)	(5.23)
CORD	19.651***	19.653***	19.652***	19.651***	19.650***
	(60.34)	(60.68)	(60.50)	(60.55)	(60.71)
M1	0.017	0.092	0.063	0.082	0.067
	(0.16)	(1.48)	(0.83)	(1.29)	(1.19)
M2	-0.085	0.009	0.005	-0.001	0.017
	(-0.82)	(0.15)	(0.06)	(-0.02)	(0.31)
M3	-0.047	-0.037	-0.048	-0.036	-0.016
	(-0.44)	(-0.60)	(-0.63)	(-0.56)	(-0.29)
M4	-0.020	0.001	-0.026	0.015	0.020
	(-0.19)	(0.01)	(-0.35)	(0.23)	(0.37)
M5	-0.005	-0.057	-0.033	-0.016	-0.012
	(-0.05)	(-0.92)	(-0.43)	(-0.26)	(-0.22)
M6	-0.123	-0.059	-0.070	-0.076	-0.036
	(-1.14)	(-0.92)	(-0.88)	(-1.15)	(-0.63)
M1&CORD	31.720***	33.842***	27.002***	29.054***	30.761***
	(4.68)	(10.07)	(6.49)	(8.56)	(10.21)
M2&CORD	31.440***	32.037***	34.611***	32.869***	31.168***
	(6.88)	(12.14)	(12.01)	(12.08)	(12.70)
M3&CORD	35.155***	32.625***	33.722***	33.470***	31.966***
	(6.51)	(11.80)	(11.20)	(12.45)	(13.03)
M4&CORD	29.894***	35.866***	37.532***	34.014***	33.734***
	(5.17)	(11.64)	(11.01)	(11.19)	(12.21)
M5&CORD	33.678***	37.710***	13.523***	13.662***	15.430***
	(5.88)	(12.04)	(6.22)	(6.54)	(7.79)
M6&CORD	16.359***	29.103***	32.523***	30.934***	32.195***
	(4.08)	(11.39)	(11.63)	(11.92)	(13.85)

	Z=NIGR	Z=NOTC	Z=SCAP	Z=NREP	Z=SSIZE
Z	-0.032	-0.027	-0.017	0.003	0.009
	(-0.93)	(-0.92)	(-0.56)	(0.10)	(0.26)
Z&M1	0.076	-0.091	0.006	-0.026	-0.092
	(0.65)	(-0.88)	(0.06)	(-0.26)	(-0.78)
Z&M2	0.139	0.044	0.028	0.096	-0.035
	(1.18)	(0.43)	(0.28)	(0.95)	(-0.29)
Z&M3	0.081	0.176*	0.119	0.162	0.121
	(0.68)	(1.70)	(1.18)	(1.59)	(1.02)
Z&M4	0.050	0.014	0.073	-0.013	-0.035
	(0.42)	(0.13)	(0.72)	(-0.13)	(-0.29)
Z&M5	-0.026	0.042	0.029	-0.001	-0.028
	(-0.22)	(0.40)	(0.28)	(-0.01)	(-0.23)
Z&M6	0.104	0.075	0.067	0.146	0.151
	(0.85)	(0.71)	(0.65)	(1.41)	(1.22)
Z&M1&CORD	-15.682**	-31.183***	-13.353***	-21.340***	-33.157***
	(-2.17)	(-6.68)	(-2.66)	(-4.56)	(-6.91)
Z&M2&CORD	-16.931***	-34.991***	-33.411***	-34.458***	-42.692***
	(-3.32)	(-8.45)	(-8.22)	(-8.39)	(-9.72)
Z&M3&CORD	-17.604***	-28.442***	-25.739***	-32.911***	-40.632***
	(-3.02)	(-6.89)	(-6.25)	(-7.87)	(-9.01)
Z&M4&CORD	-7.999	-27.574***	-25.666***	-24.504***	-31.959***
	(-1.27)	(-6.12)	(-5.66)	(-5.42)	(-6.72)
Z&M5&CORD	-22.713***	-35.624***	-1.205	-1.937	-10.873***
	(-3.78)	(-9.49)	(-0.33)	(-0.51)	(-2.58)
Z&M6&CORD	6.602	-18.192***	-21.608***	-22.304***	-36.899***
	(1.44)	(-4.66)	(-5.58)	(-5.71)	(-8.71)

Panel data analysis (random effect model) of daily returns of convertible preferred stocks using equation:

$$\begin{aligned} CVRD_i = a + b_1 RATE_i + b_2 CORD_i + \sum_{n=1}^{n=6} b_{n+2} M_n + \sum_{n=1}^{n=6} b_{n+8} M_n CORD_i \\ + b_{15} Z_i + \sum_{n=1}^{n=6} b_{n+15} Z_i M_n + \sum_{n=1}^{n=6} b_{n+21} Z_i M_n CORD_i + e_i \end{aligned} \tag{27}$$

where for security *i*: *CVRD* is the convertible daily returns measured using closing mid-spread prices, *CORD* is the underlying common stock daily returns measured using closing mid-spread prices, *RATE* is the daily change in the estimated 30-year zero-coupon Treasury rates, *M1-M6* are the first through six months dummies, *Z* is a convertible characteristic dummy, which is *NIGR* for the non-investment grade and non-rated convertibles, *NOTC* for issues traded on NASDAQ and/or OTC, *SCAP* for small cap firm issues, *NREP* for the issues that were underwritten by non-reputable investment bankers, *SSIZE* for issues with less than $50 million in offering proceeds. Parameter estimates are presented, with t-statistics in parentheses. All coefficients are multiplied by 100. *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

Table 17. Convertible Preferred Stock Weekly Returns Panel Estimates

	Z=NIGR	*Z=NOTC*	*Z=SCAP*	*Z=NREP*	*Z=SSIZE*
Constant	0.141**	0.065*	0.074	0.018***	0.018
	(2.21)	(1.72)	(1.57)	(0.53)	(0.53)
RATE	76.761***	75.842***	73.436***	70.238***	76.579***
	(4.88)	(4.84)	(4.68)	(4.68) ***	(4.90)
CORW	30.505***	30.508***	30.506***	35.789	30.508***
	(110.46)	(110.95)	(110.78)	(125.06)	(111.15)
M1	-0.020	0.139	-0.086	0.174	0.034
	(-0.10)	(1.09)	(-0.55)	(1.40)	(0.29)
M2	-0.169	-0.108	-0.244*	-0.125	-0.089
	(-0.89)	(-0.96)	(-1.79)	(-1.13)	(-0.88)
M3	-0.087	-0.025	0.044	-0.059	0.036
	(-0.45)	(-0.22)	(0.31)	(-0.52)	(0.35)
M4	-0.204	-0.084	-0.168	-0.008	0.030
	(-1.05)	(-0.74)	(-1.21)	(-0.07)	(0.29)
M5	-0.020	-0.132	-0.112	-0.036	-0.019
	(-0.11)	(-1.17)	(-0.81)	(-0.33)	(-0.19)
M6	-0.147	-0.185	-0.183	-0.226**	-0.064
	(-0.70)	(-1.56)	(-1.24)	(-1.94)	(-0.60)
M1&CORW	31.967***	32.485***	22.808***	21.462***	29.530***
	(5.20)	(13.25)	(6.94)	(8.33)	(13.19)
M2&CORW	30.845***	27.575***	29.007***	18.083***	26.538***
	(9.98)	(14.15)	(13.41)	(10.95)	(14.81)
M3&CORW	27.861***	26.287***	30.648***	23.279***	27.813***
	(6.01)	(12.86)	(13.59)	(12.50)	(15.39)
M4&CORW	20.207***	27.124***	31.543***	22.555***	27.142***
	(4.51)	(12.42)	(13.25)	(11.02)	(14.01)
M5&CORW	24.422***	23.129***	13.606***	8.888***	14.442***
	(5.95)	(9.69)	(7.91)	(5.72)	(9.44)
M6&CORW	32.879***	32.885***	37.367***	26.723***	32.460***
	(8.84)	(16.07)	(16.03)	(13.45)	(17.35)

	Z=NIGR	Z=NOTC	Z=SCAP	Z=NREP	Z=SSIZE
Z	-0.150**	-0.117*	-0.086	0.030	0.022
	(-2.10)	(-1.90)	(-1.38)	(0.56)	(0.30)
Z&M1	0.283	-0.074	0.457**	-0.028	-0.206
	(1.18)	(-0.35)	(2.23)	(-0.14)	(-0.82)
Z&M2	0.150	0.214	0.326*	0.114	0.077
	(0.70)	(1.15)	(1.80)	(0.64)	(0.35)
Z&M3	0.215	0.327*	0.096	0.419**	0.165
	(0.98)	(1.71)	(0.52)	(2.33)	(0.75)
Z&M4	0.319	0.299	0.346	0.019	-0.031
	(1.45)	(1.59)	(1.89)	(0.11)	(-0.14)
Z&M5	-0.025	0.189	0.177	0.033	0.028
	(-0.12)	(0.98)	(0.96)	(0.18)	(0.12)
Z&M6	0.066	0.330*	0.127	0.454**	0.495**
	(0.28)	(1.71)	(0.66)	(2.47)	(2.15)
Z&M1&CORW	-14.769**	-38.022***	-5.924	-16.006***	-48.190***
	(-2.28)	(-9.43)	(-1.46)	(-4.30)	(-10.06)
Z&M2&CORW	-11.398***	-17.653***	-15.114***	-11.126**	-25.004***
	(-3.13)	(-4.80)	(-4.55)	(-2.08)	(-5.46)
Z&M3&CORW	-6.622	-11.663***	-17.724***	-22.204***	-30.232***
	(-1.34)	(-3.47)	(-5.48)	(-6.54)	(-7.33)
Z&M4&CORW	5.228	-6.446*	-14.358***	-9.257***	-11.788***
	(1.08)	(-1.85)	(-4.23)	(-2.72)	(-2.90)
Z&M5&CORW	-11.358***	-12.743***	2.236	1.148	-0.123
	(-2.62)	(-4.39)	(0.80)	(0.40)	(-0.04)
Z&M6&CORW	-16.199***	-29.804***	-30.766***	-28.085***	-39.505***
	(-3.99)	(-9.90)	(-10.14)	(-9.73)	(-12.33)

Panel data analysis (random effect model) of weekly returns of convertible preferred stocks using equation:

$$\begin{aligned} CVRW_i = a + b_1 RATE_i + b_2 CORW_i + \sum_{n=1}^{n=6} b_{n+2} M_n + \sum_{n=1}^{n=6} b_{n+8} M_n CORW_i \\ + b_{15} Z_i + \sum_{n=1}^{n=6} b_{n+15} Z_i M_n + \sum_{n=1}^{n=6} b_{n+21} Z_i M_n CORW_i + e_i \end{aligned} \tag{27}$$

where for security *i*: *CVRW* is the convertible weekly returns measured using closing mid-spread prices, *CORW* is the underlying common stock weekly returns measured using closing mid-spread prices, *RATE* is the weekly change in the estimated 30-year zero-coupon Treasury rates, *M1-M6* are the first through six months dummies, *Z* is a convertible characteristic dummy, which is *NIGR* for the non-investment grade and non-rated convertibles, *NOTC* for issues traded on NASDAQ and/or OTC, *SCAP* for small cap firm issues, *NREP* for the issues that were underwritten by non-reputable investment bankers, *SSIZE* for issues with less than $50 million in offering proceeds. Parameter estimates are presented, with t-statistics in parentheses. All coefficients are multiplied by 100. *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

Table 18. Convertible Preferred Stock Monthly Returns Panel Estimates

	Z=NIGR	*Z=NOTC*	*Z=SCAP*	*Z=NREP*	*Z=SSIZE*
Constant	0.320	0.074	0.050	-0.075	-0.079
	(1.58)	(0.56)	(0.30)	(-0.56)	(-0.62)
RATE	-15.686	-16.008	-17.186	-16.767	-13.768
	(-1.10)	(-1.13)	(-1.21)	(-1.20)	(-0.97)
CORM	31.192***	31.203***	31.203***	32.867***	31.222***
	(120.25)	(120.51)	(120.26)	(126.20)	(120.44)
M2	-0.298	0.001	-0.750***	0.083	-0.168
	(-0.91)	(0.01)	(-3.12)	(0.42)	(-0.93)
M3	0.021	0.248	0.341	0.032	0.372**
	(0.06)	(1.24)	(1.40)	(0.16)	(2.05)
M4	-0.511	-0.214	-0.220	0.028	0.111
	(-1.48)	(-1.07)	(-0.89)	(0.14)	(0.61)
M5	-0.379	-0.159	0.043	0.367*	0.355**
	(-1.06)	(-0.76)	(0.17)	(1.81)	(1.96)
M6	-0.396	-0.419**	-0.532**	-0.528**	-0.077
	(-1.16)	(-2.03)	(-2.12)	(-2.57)	(-0.41)
M2&CORM	34.298***	32.347***	28.956***	26.024***	31.336***
	(9.44)	(17.53)	(12.53)	(16.57)	(18.64)
M3&CORM	32.015***	26.809***	29.358***	24.453***	27.202***
	(9.79)	(16.24)	(16.33)	(15.64)	(18.35)
M4&CORM	25.163***	31.110***	33.488***	28.247***	28.415***
	(5.27)	(13.70)	(12.13)	(13.10)	(14.65)
M5&CORM	29.061***	27.393***	16.015***	15.203***	17.216***
	(9.05)	(12.35)	(9.91)	(10.01)	(11.66)
M6&CORM	35.193***	31.552***	29.443***	26.619***	28.163***
	(13.05)	(16.94)	(15.09)	(15.67)	(17.54)

	Z=NIGR	Z=NOTC	Z=SCAP	Z=NREP	Z=SSIZE
Z	-0.396*	-0.195	-0.072	0.237	0.358
	(-1.85)	(-1.01)	(-0.32)	(1.12)	(1.37)
Z&M2	0.376	0.178	1.287***	-0.327	-0.106
	(1.00)	(0.53)	(4.02)	(-1.00)	(-0.27)
Z&M3	0.730*	0.705**	0.322	1.160***	0.407
	(1.79)	(2.10)	(0.99)	(3.51)	(1.04)
Z&M4	0.783**	0.920***	0.619*	0.120	-0.141
	(2.00)	(2.71)	(1.88)	(0.37)	(-0.36)
Z&M5	0.879**	0.669*	0.692**	-0.069	-0.198
	(2.19)	(1.87)	(2.11)	(-0.21)	(-0.46)
Z&M6	0.366	0.996***	0.552*	0.955***	0.229
	(0.94)	(2.92)	(1.66)	(2.88)	(0.56)
Z&M2&CORM	-9.147**	-17.448***	-4.032	-20.352*	-29.240***
	(-2.29)	(-5.30)	(-1.32)	(-1.92)	(-6.84)
Z&M3&CORM	-8.742**	-4.429	-9.518***	-4.217	-13.928***
	(-2.41)	(-1.44)	(-3.37)	(-1.28)	(-3.12)
Z&M4&CORM	4.387	-6.314*	-8.384**	-3.415	2.446
	(0.86)	(-1.81)	(-2.37)	(-0.99)	(0.58)
Z&M5&CORM	-17.428***	-19.801***	-3.878	-9.304***	-15.939***
	(-4.95)	(-6.99)	(-1.37)	(-3.04)	(-4.38)
Z&M6&CORM	-17.986***	-20.670***	-14.412***	-16.882***	-21.194***
	(-5.84)	(-7.88)	(-5.48)	(-6.46)	(-7.44)

Panel data analysis (random effect model) of monthly returns of convertible preferred stocks using equation:

$$CVRM_i = a + b_1 RATE_i + b_2 CORM_i + \sum_{n=2}^{n=6} b_{n+1} M_n + \sum_{n=2}^{n=6} b_{n+6} M_n CORM_i$$
$$+ b_{13} Z_i + \sum_{n=2}^{n=6} b_{n+12} Z_i M_n + \sum_{n=2}^{n=6} b_{n+17} Z_i M_n CORM_i + e_i \qquad (27)$$

where for security i: *CVRM* is the convertible monthly returns measured using closing mid-spread prices, *CORM* is the underlying common stock monthly returns measured using closing mid-spread prices, *RATE* is the weekly change in the estimated 30-year zero-coupon Treasury rates, *M2-M6* are the second through six months dummies, *Z* is a convertible characteristic dummy, which is *NIGR* for the non-investment grade and non-rated convertibles, *NOTC* for issues traded on NASDAQ and/or OTC, *SCAP* for small cap firm issues, *NREP* for the issues that were underwritten by non-reputable investment bankers, *SSIZE* for issues with less than $50 million in offering proceeds. Parameter estimates are presented, with t-statistics in parentheses. All coefficients are multiplied by 100. *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

Historical Price Track Method

Parameter estimates for (28), (29) and (30) are presented in Table 19. All coefficients of weekly and monthly dummy variables are negative and significant. Coefficients of daily dummies are negative and marginally significant.

Results are interpreted as follows. During the first five days following issuance, convertible preferreds are underpriced between \$0.94 (on the 1st day) and \$0.99 (on the 5th day). During the four weeks following issuance underpricing ranges from \$0.99 (during the 1st week) down to \$0.47 (during the 4th week). For the 1st month following issuance, underpricing averages \$0.80 dropping to about \$0.30 by the 6th month. The average price of convertibles immediately following issuance is about \$35.

To assess the robustness of the results to the estimation period, I re-estimated models (28), (29) and (30) over a shorter period (one-year) following issuance. Results are largely similar although the magnitudes of the coefficients are slightly smaller. In summary, the historical price track method supports the hypothesis that convertibles are underpriced following issuance (significant at the 1% level) for up to 4 months.

Table 19. Pricing of Convertible Preferred Stock Panel Estimates

	Constant	*LCOM*	*D1*	*D2*	*D3*	*D4*	*D5*	
Equation	-7.533***	14.769***	-0.938*	-0.958*	-0.986*	-0.946*	-0.990*	
(28)	(-3.65)	(154.80)	(-1.91)	(-1.89)	(-1.94)	(-1.86)	(-1.94)	
	Constant	*LCOM*	*W1*	*W2*	*W3*	*W4*		
Equation	-7.607***	14.802***	-0.986***	-0.680***	-0.536**	-0.471**		
(29)	(-3.68)	(154.66)	(-4.34)	(-2.95)	(-2.32)	(-2.02)		
	Constant	*LCOM*	*M1*	*M2*	*M3*	*M4*	*M5*	*M6*
Equation	-7.991***	14.974***	-0.798***	-0.680***	-0.509***	-0.632***	-0.259**	-0.296**
(30)	(-3.87)	(152.92)	(-6.73)	(-5.63)	(-4.21)	(-5.21)	(-2.12)	(-2.42)

Panel data analysis (random effect model) of daily returns of convertible preferred stocks using equations:

$$CVP_i = a + b_1 LCOM_i + \sum_{n=1}^{n=5} b_{n+1} D_n + e_i \tag{28}$$

$$CVP_i = a + b_1 LCOM_i + \sum_{n=1}^{n=4} b_{n+1} W_n + e_i \tag{29}$$

$$CVP_i = a + b_1 LCOM_i + \sum_{n=1}^{n=6} b_{n+1} M_n + e_i \tag{30}$$

where: *CVP* is the convertible daily mid-spread closing prices, *LCOM* is the natural logarithm of underlying common stock daily mid-spread closing prices, *D1-D5* are the first through fifth day of trading dummies, *W1-W4* are the first through fourth week of trading dummies, and *M1-M6* are the first through sixth month of trading dummies. Parameter estimates are presented, with t-statistics in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

Volatility of Convertible Preferreds versus Common Stocks

The ratio of convertible to common standard deviation, $\gamma = \sigma_{cv} / \sigma_{com}$, is displayed in Table 20 for the whole sample as well as according to the five characteristic of the issue: rating, exchange listing, firm size, underwriter reputation and offering size. I estimate mean values of the ratio ($\bar{\gamma}$) for days 60-150 ($\bar{\gamma}_{60:150}$) and days 150-480 ($\bar{\gamma}_{150:480}$). The 60th day is the first day volatility can be reliably measured; the 150th day is the transition point where volatility is measured using daily returns predominantly from the first 120 versus the next 360 trading days, i.e., the first six versus the next 18 months.

Surprisingly, $\bar{\gamma}_{60:150}$ is less than $\bar{\gamma}_{150:480}$ for the whole sample as well as for almost every subsample (excluding NASDAQ/OTC traded issues, non-reputable underwriter issues and small cap issues, where there is no significant difference). In short, the excess returns/underpricing during the 4-5 months following issuance cannot be attributed to excess volatility of the convertible. In contrast, the volatility results indicate risk-adjusted excess returns following issuance may actually be higher than reported.

Another interesting observation is that within each sub-sample (according to ratings, exchange listing, firm size, underwriter reputation, and offering size) regardless of the sub-periods (60-150 versus 150-480 days), the relative sizes of $\bar{\gamma}$ indicate that for non-investment grade, NASDAQ/OTC traded, small firm, non-reputable and small size issues, convertibles are proportionately less risky than their underlying common relative to the counterpart securities (for example, $\bar{\gamma}_{60:150}$ and $\bar{\gamma}_{150:480}$ are both smaller for non-investment grade issues than issues with investment grade). Robustness of this finding is apparent in Figure 4, which displays volatility measures for the entire estimation period.

These volatility measures indicate why cross-sectional variation of the convertible's excess returns in the early period following issuance is elusive: while securities with more risky characteristic (for example, non-investment grade issues versus investment grade issues) are likely to face greater underpricing thereby offering greater excess returns following issuance, these securities are apparently designed (by virtue of the choice of their contract parameters) to share less of the risk of their respective common stocks (indeed, this is exactly what is indicated in Tables 16-18). I speculate, for example, the net impact of ratings on the one hand and prudent security design on the other mitigates cross-sectional variation of excess returns based on ratings.

Table 20. Ratios of Convertible to Underlying Common Stock Standard Deviations

			Means of the standard deviation ratios		*Difference in means*
Groups		*Issues*	*60-150 trading days after issuance*	*150-480 trading days after issuance*	$\bar{\gamma}_{150:480} - \bar{\gamma}_{60:150}$
A	All Sample	All Convertible Preferred Stocks	0.8061	0.8414	0.03537*** (5.296)
B	By Rating	Investment Grade	0.8531	0.8852	0.03209*** (2.784)
		Speculative Grade and Non-rated	0.7939	0.8310	0.03703*** (4.736)
C	By Exchange	NYSE/AMEX traded	0.8911	0.9470	0.05591*** (8.109)
		NASDAQ/OTC traded	0.6397	0.6523	0.01262 (0.977)
D	By Firm Size	Large Cap Firms	0.8799	0.9669	0.08700*** (5.447)
		Medium Cap Firms	0.8706	0.9113	0.04073*** (4.473)
		Small Cap Firms	0.7527	0.7778	0.02503** (2.544)
E	By Underwriter Reputation	Highly Reputable	0.8529	0.9125	0.05953*** (8.795)
		Less Reputable	0.7361	0.7443	0.00813 (0.640)
F	By Size of Offerings	Large Size Offerings	0.8181	0.8505	0.03237*** (3.379)
		Medium Size Offerings	0.8463	0.9111	0.06481*** (8.149)
		Small Size Offerings	0.7050	0.6973	-0.00775 (-0.400)

The daily returns of convertible preferred and common stocks are calculated using daily mid-spread closing prices. The standard deviations are estimated using daily returns of preceding 60 trading days. The ratio of standard deviations is calculated as $\gamma = \sigma_{cv} / \sigma_{com}$, where σ_{cv} is the standard deviation of convertible daily returns and σ_{com} is the standard deviation of underlying common stock daily returns. T-statistics is shown in parentheses. **, and *** indicate significance at the 5%, and 1% levels respectively.

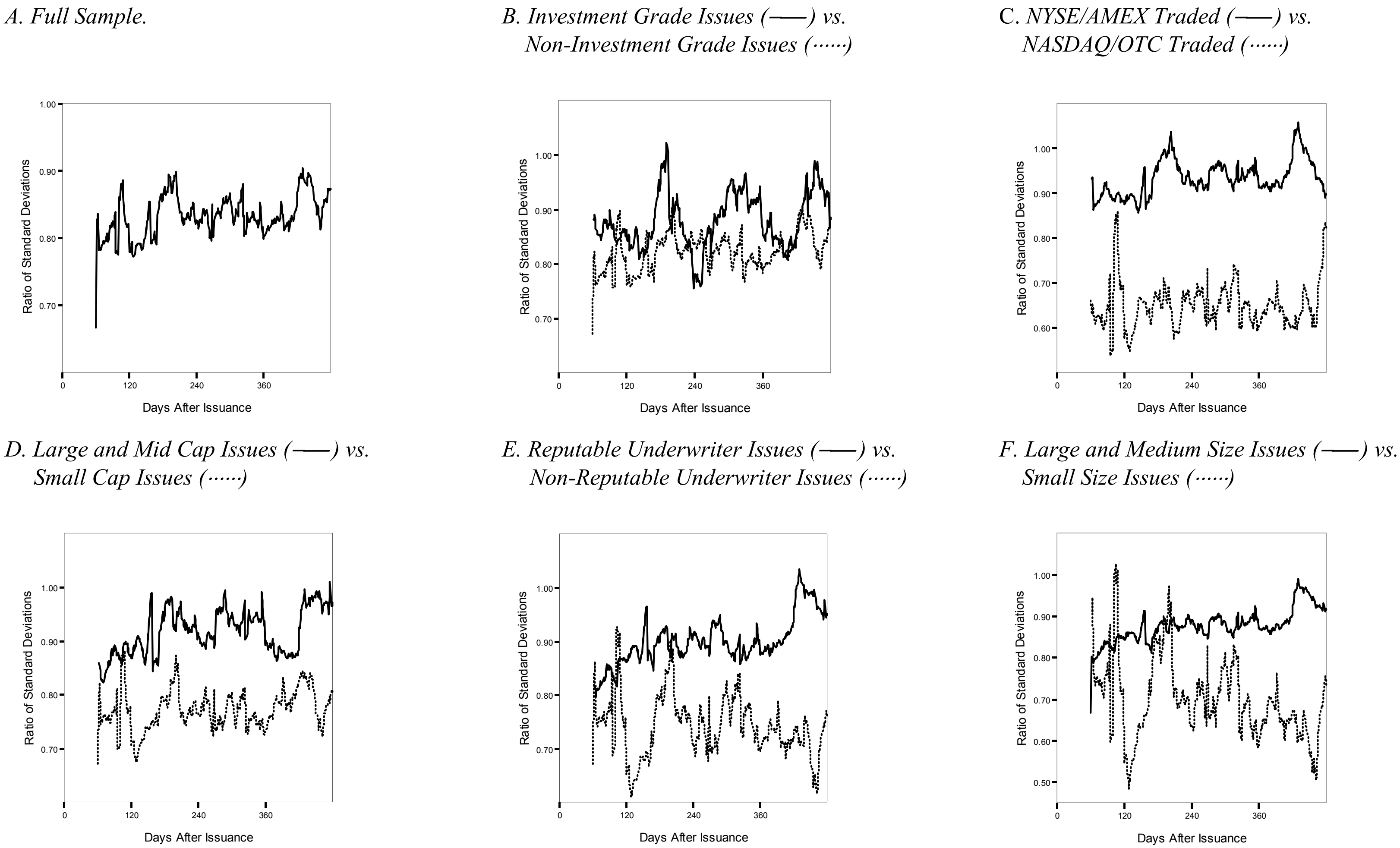


Figure 4. Ratio of Convertible to Underlying Common Stock Standard Deviations

The daily returns of convertible preferred and common stocks are calculated using daily mid-spread closing prices. The standard deviations are estimated using daily returns of preceding 60 trading days. The ratio of standard deviations is calculated as $\gamma = \sigma_{cv} / \sigma_{com}$, where σ_{cv} is the standard deviation of convertible daily returns and σ_{com} is a standard deviation of underlying common stock daily returns.

CHAPTER FIVE: CONCLUSION

Using an option-based valuation model and two samples of convertible preferred stock offerings I provide evidence of underpricing that varies approximately from 2.9% to 1.4% and decreases with time following issuance. The underpricing is statistically and economically significant and can explain abnormal performance of convertibles over the past thirty years reported by Lummer and Riepe (1993) and subsequent updates by Goldman Sachs (2001).

Cross-sectional analysis of underpricing reveals several interesting results. Some of the results are counterintuitive and show that convertibles do not always follow the underpricing patterns reported by equity IPO literature. I find that mid and large cap issues are significantly underpriced, whereas small cap issues exhibit virtually no underpricing. Also, NYSE/AMEX listed issues are more likely to be underpriced than issues listed on NASDAQ/OTC. In addition, there is indication that investment grade issues are more largely underpriced than non-investment grade issues.

In contrast, there are other intuitive findings. While reputable underwriter issues are underpriced for six months following issuance, non-reputable underwriter issues are underpriced even more. Also, there is an indication that while mid/large size issues are underpriced for the first six month following issuance, small size issues show even more underpricing for the first four months.

The cross-sectional results are interesting since Kang and Lee (1996) find virtually no cross-sectional variation of mispricing in their study of convertible bonds. Discovery of cross-sectional variation in convertible security mispricing in this study can be attributed to the increased statistical power of options-based valuation models when assessing the value of corporate contingent claims.

The empirical analysis affirms the underpricing detected by the valuation model. The underpricing of convertible preferred stocks at issuance is supported by statistically significant holding-period excess returns of convertibles over their underlying common stock returns that range from 0.81% for the first week to 2.04% for the first five months following issuance. These findings are at odds with previous studies by Loderer, Sheehan and Kadlec (1991) for convertible preferreds and Kang and Lee (1996) for convertible bonds. However, similar to Kang and Lee's findings on cross-sectional variation of their first-day excess returns, I find that excess returns are invariant to security ratings, exchange listing, firm size, underwriter reputation and the size of the issue.

Panel data analysis of daily returns suggests excess returns of 1.1 percent (1.8 percent) for the first week (month) following issuance. This affirms my findings in relation to holding-period returns. More importantly, I find that excess returns can be explained by increased sensitivity of convertible returns to the returns of their underlying common stocks in the first six months following issuance. This is a new finding that suggests excess returns following issuance can be attributed to higher "systematic" risk of the convertible relative to the underlying common. This finding carries through to the cross-sectional analysis. In particular, cross-sectional variations of this increased sensitivity indicates investment-grade issues, listed on

NYSE/AMEX, by large firms, using reputable underwriters and for large issues are more sensitive to the underlying common stock in the first six month following issuance than securities with opposing characteristics. To date, no theory has been put forth that may explain why these issues display greater “systematic” risk immediately following issuance.

Underpricing at issuance is also indicated by investment models favored by convertible trading desks (the historical price track model): about one dollar on an average price of thirty five during the first week following issuance with underpricing persisting up to six months following issuance. This finding is particularly interesting in light of the fact that it indicates the historical price track model may actually have a basis in theory as opposed to merely providing an empirical specification for investing.

Excess returns cannot be attributed to low liquidity, high betas of underlying stock or excess volatility of convertibles following issuance. Conversely, volatility analysis indicates risk-adjusted excess returns are likely to be higher than reported.

Another interesting finding of the study is the low relative volatility of potentially high risk securities (non-investment grade, traded on NASDAQ/OTC, small cap and small size issues, and offerings that were not underwritten by reputable investment bankers). Apparently, firms that issue such convertible securities, manage to decrease risk associated with them modifying contractual provisions accordingly. Further investigation of the contract design practices of high risk firms may bring additional insights to the analysis of convertible pricing and performance.

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