

# Using A Two Treatment Factorial Design To Analyze The First Day Percent Change In Price For Initial Public Offerings

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## ABSTRACT

*An area of considerable interest in finance is the behavior of IPO stock prices on the first day of issue. This paper uses a sample of 282 IPOs from 2002 through 2007 to investigate the performance of the first day percent change in price (FDPCP) of these stocks. A two treatment factorial design is utilized to determine if two factors impact the mean value of this variable. The first factor, or treatment, is the relationship between the final offer price and the price range found in the prospectus associated with SEC Form S-1, also known as the "red herring." The second treatment is the state of the market at the time of issue, bull or bear. This experimental design allows for the testing of three hypotheses. The first hypothesis looks at the relationship between the mean value of the FDPCP and the value of the final offer price relative to the filing range found in the initial prospectus. The second hypothesis looks at the relationship between the mean value of the FDPCP and the state of the market at the time of issue, while the third hypothesis seeks to determine if there is an interaction between the two treatments.*

**Keywords:** Factorial Design, Two-Way Analysis of Variance, IPO Pricing, First Day Percent Change in IPO Price  
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## INTRODUCTION

Pricing the stock of a firm making its initial public offering is a difficult undertaking. Of course, there is less historical operating data that can be used to help determine the appropriate offer price coupled with no market data. Furthermore, the final offer price must be chosen in such a way as to attract investors, provide the desired amount of venture capital, allow the sale of the entire issue and hopefully avoid leaving money on the table.

When a firm decides to go public, the SEC requires the submission of Form S-1. This form includes an initial prospectus with a preliminary range for the offer price. Subsequent to the filing of form S-1, the underwriting bank (or syndicate, if there is more than one underwriter) then meets with prospective investors to promote and market the issue. This series of meetings with potential investors is referred to as the road show. The road show allows the underwriter or syndicate to build a book of orders for the new issue. Additionally, the road show and process of book building permit the underwriter or syndicate to get a better feel for the actual demand for the IPO. This additional knowledge of investor sentiment for the issue may result in an adjustment to the offer price either below (in the case of low demand) or above (in the case of high demand) the filing range as stated in the initial prospectus.

One well established feature of an IPO is the first day price increase, known as the first day "pop." For a variety of reasons, both rational and irrational, IPO stocks are consistently underpriced. Investors who sell the newly issued stock on the first day of trading (known as "flipping" the stock) typically experience a large gain. For

example, 72.3% of the stocks analyzed in this study had first day gains, as opposed to losses 17.4% of the time and 10.3% break-evens. However, there is considerable variation in the first day percent change in the price of these stocks. The purpose of this paper is to examine the role of two factors that may affect the first day percent change in price - the relationship between the final offer price and the filing range in the preliminary prospectus (below, within, or above), and the state of the market at the time of issue (bear or bull).

**REVIEW OF LITERATURE**

Most studies of the behavior of FDPCP focus on the fact that IPOs are consistently underpriced. The dominant strand of the IPO underpricing literature posits that underpricing occurs due to information asymmetries that cause adverse selection in allocating share (Rock, 1986), or because underpricing is needed to entice informed investors to reveal information to the underwriters, as in the book building models that start with Benveniste and Sprint (1989). Other theories of underpricing are based on agency problems in which the underwriters objective function departs from that of the issuer (Boehmer and Fishe, 2000), (Bias et. al, 2002) (Loughran and Ritter, 2004), Ritter and Welch (2002) claim there are no rational theoretical models that fully explain initial underpricing. Ljunqvist, Nanda, and Singh (2003) present a behavioral model that generates all three phenomena. For a discussion of these issues see Viswanathan and Wei (2004). De Jong and Dahlquist (2003), Schultz (2003), Loughran and Ritter (2000) and Brav, Geezy and Gompers (2000).

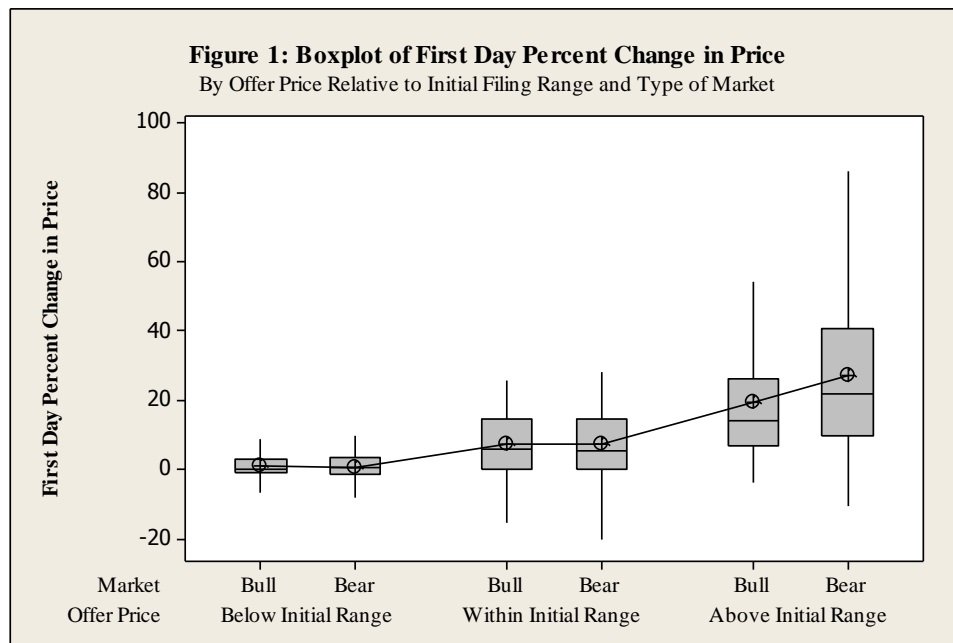
In the theoretical model of Booth and Chua (1996), underpricing is employed to increase the base of investors that are interested in the new issue and increase aftermarket liquidity. In Westerfield (2003), underpricing is also used to influence the composition of the investor base. If Booth and Chua are correct, then underpricing should be negatively correlated with illiquidity, but this runs counter to the empirical results in Ellut and Pagano, and hence casts doubt on the empirical relevance of Booth and Chua’s model. In a related work, Adams, Thornton and Hall (2008) present a behavioral model in which underpricing results from asymmetric information difference between the issuer and the investor. If investors are more informed than the issuer (e.g., about demand for shares), then the issuer faces a pricing paradox. Pricing an offer too high can lead to investor fear of the “winner’s curse” and the resulting information cascades. If the issuer is better informed than investors, pricing an offer too low often leads to investor’s reluctance due to their perception of the “lemons” problem associated with the IPO allocation of shares.

**DATA AND METHODOLOGY**

A random sample of 282 IPOs was selected from Renaissance Capital’s IPOhome.com and Hoovers for the analysis. Descriptive statistics for the variable of interest, FDPCP, are presented in Table 1. Figure 1 is a boxplot that provides a graphical presentation of the same information. The descriptive statistics and boxplot suggest that there is very little difference in the mean value of FDPCP across the two states of the market, and considerable difference in mean FDPCP by the relationship between the final offer price and the original filing range.

**Table 1: Descriptive Statistics for First Day Percent Change in Price**

Market	Final Offer Price Relative to Initial Range	Mean	S.D.	n
Bear	Below	1.16%	10.56%	47
	Within	7.42%	12.98%	47
	Above	19.13%	18.25%	47
	Total	9.24%	16.04%	141
Bull	Below	0.31%	7.25%	47
	Within	7.01%	10.56%	47
	Above	23.66%	23.66%	47
	Total	11.53%	19.24%	141
Both	Below	0.73%	9.02%	94
	Within	7.21%	11.77%	94
	Above	23.20%	21.41%	94
	Total	10.38%	17.72%	282



A two-treatment factorial design was utilized to analyze the behavior of FDPCP. This allowed for the investigation of 2 main effects and 1 interaction effect. The first main effect is the impact of the value of the final offer price relative to the initial filing range on the mean value of FDPCP. The second main effect is the influence of the state of the market on the mean value of FDPCP. An interaction effect exists if there is any relationship between the two main effects. An interaction between the two main effects precludes any further analysis of the main effects, if such analyses are warranted.

The three effects can be thought of in terms of three hypothesis tests. The statistical procedure employed in a two-treatment factorial design is a two-way analysis of variance (ANOVA). All three hypothesis tests were tested at the five percent level of significance. The three hypotheses associated with the three effects of the two-treatment factorial design are listed below:

**Null Hypothesis 1:** There is no difference in the mean value of FDPCP by the value of the final offer price relative to the initial filing range.

**Alternate Hypothesis 1:** There is a difference in the mean value of FDPCP by the value of the final offer price relative to the initial filing range.

**Null Hypothesis 2:** There is no difference in the mean value of FDPCP by the state of the market.

**Alternate Hypothesis 2:** There is a difference in the mean value of FDPCP by the state of the market.

**Null Hypothesis 3:** There is no interaction between the state of the market and the value of the final offer price relative to the initial filing range.

**Alternative Hypothesis 3:** There is an interaction between the state of the market and the value of the final offer price relative to the initial filing range.

## RESULTS

Table 2 summarizes the results of the two-way ANOVA performed on the sample data. If the p-value for an effect is less than the stated level of significance (0.05), the null hypothesis should be rejected.

**Table 2: Two-Way Analysis of Variance Results**

Effect	Computed F	P-Value
Main Effect 1: Offer Price Relative to Initial Price Range	56.44	0.000
Main Effect 2: State of Market	1.66	0.198
Interaction Effect	2.71	0.068

The evidence from the sample shows that there is no interaction effect, so an analysis of the main effects can be undertaken. The results of the two-way ANOVA indicate that the state of the market has no effect on the mean value of FDPCP, so no additional analysis is required. However, the results imply that the mean value of FDPCP is affected by the value of the offer price relative to the range in the prospectus that accompanies SEC Form S-1.

Table 3 shows 95% confidence intervals for the difference in the mean value of FDPCP among all 3 pairwise comparisons based on the value of the IPO's final offer price relative to the filing range in the preliminary prospectus. These intervals were constructed using Tukey's method. If an interval contains the value zero, it can be concluded that the two groups could share the same mean. In such a case, there is no significant difference in the mean value between the two groups. Similarly, if the interval does not contain the value zero, there is a significant difference in the mean value between the two groups.

**Table 3: 95% Confidence Intervals for the Difference in the Mean Value of FDPCP**

Offer Price Relative to Initial Range	Lower Confidence Limit	Upper Confidence Limit
Within – Below	1.35%	11.62%
Above - Below	17.34%	27.61%
Above - Within	10.86%	21.13%

Table 3 demonstrates that the mean value of FDPCP for the “within” group is at least 1.35% higher than that of the “below” group, and that it could be as much as 11.62% higher when the effects of sampling error are taken into consideration. The other pairwise comparisons are analyzed in a similar way. The analysis indicates that the mean value of FDPCP is significantly higher for the “above” group than for both the “within” and “below” groups. Moreover, the mean value of FDPCP is significantly higher for the “within” group than for the “below” group.

## CONCLUSIONS

The first conclusion is that the first day performance of IPOs is robust with respect to the state of the market. Whether the stocks are issued during a bear or bull market doesn't appear to affect the first day performance of these stocks. The second conclusion reached is that the first day performance of IPOs depends largely on the value of the final offer price relative to the price range submitted in the original prospectus. In particular, IPOs that have experienced a price adjustment above the initial filing range have an average gain of more than 23% in the first day of trading. Even those IPOs with final offer prices within the initial filing range have an expected gain of 7% associated with a holding period of only one day. These two results compare quite favorably to those IPOs with price adjustments below the preliminary filing range, with a mean first day percent change in price of less than 1%.

This difference in first day performance can be seen in the Table 4, which only considers whether an IPO stock made a gain, loss, or broke-even on the first day of trading. The conclusion that can be drawn from this table and the preceding analysis is dramatic. An IPO stock that has had its offer price adjusted above the initial filing range is as close to a “sure thing” that one can find in the world of investing.

**Table 4: Distribution of Gains, Losses, and Break-Evens in First Day Trading**

Offer Price Relative to Initial Range	First Day Gain	First Day Break-Even	First Day Loss
Below	53.19%	17.02%	29.79%
Within	69.15%	11.70%	19.15%
Above	94.68%	2.13%	3.19%
Total	72.34%	10.28%	17.38%

The message for investors is clear. IPOs that have an offer price adjusted above the filing range found in the preliminary prospectus have a high probability of generating a favorable outcome. Of course, this begs the most important question of all – which investors have access to such IPOs?

The final conclusion is that IPOs are consistently underpriced, both in the U.S. and foreign markets. If this were not the case, the distribution of gains, losses, and break-evens would be more uniform and the expected first day percent change in price would be close to zero. The evidence from this study strongly suggests that this is clearly not the case. The advantages of underpricing for the investor have already been discussed, so it remains to be determined how underpricing IPOs benefits the other two participants in the IPO transaction. The other participants are the underwriter (or underwriters, in the case of a syndicated offering) and the issuing firm.

Investment banks assume a risk in underwriting an IPO. It is possible that all shares will not sell at the offer price (a “broken issue”). Since the underwriter typically purchases all shares from the issuing firm, the underwriting firm could end up with an inventory of unsold shares in the case of an unsuccessful offer. This fact helps to explaining the prevalence of the systematic underpricing that is seen in the IPO market. However, this underpricing comes at a cost to the investment bank in the form of smaller commissions generated.

An underpriced IPO has another advantage for an investment bank. These underwriters determine the allocation of the IPO shares, and provide a way for underwriters to benefit investors who have been good customers, or may become customers in the future. This offers a partial answer to the question asked above – what investors have access to the desirable IPOs that have offer prices above the initial filing range?

Presumably, the participant that would be most opposed to the systematic underpricing of IPOs is the issuing firm. Underpricing leaves significant amount of “money left on the table.” It’s plausible to assume that investors would have been willing to purchase the stock at the higher first day closing price in the secondary market. However, issuing firms and original shareholders fear a “broken issue” as much as do underwriters. The negative publicity associated with such an issue, along with the failure to raise the desired amount of capital, provides a strong incentive to insure the entire issue is sold. The easiest way to accomplish this goal is through underpricing.

The analysis of the sample of IPOs in this paper has generated three important facts about the first day performance of these stocks. First, the state of the market does not significantly affect the mean value of FDPCP. Second, the relationship between the final offer price and the initial filing range profoundly affects the mean value of this variable. In particular, if the final offer price is adjusted to be above the initial filing range, a large first day gain can be expected. Finally, there is little interaction between the state of the market and the relationship between the final offer price of an IPO and the filing range found in its preliminary prospectus.

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**NOTES**