The Initial Maximum Pricing Range Estimate Decision in IPOs: Is Low-balling or High-balling the Optimal Strategy?

PRELIMINARY AND INCOMPLETE DRAFT. Please do not cite or distribute without author's permission.

Patrick M. Corrigan*

Notre Dame Law School

November 4, 2020

Abstract

Using instrumental variable analysis, I show that the initial maximum pricing range estimate (IMPRE) by a company contemplating an initial public offering (IPO), submitted weeks *before* an IPO, affects IPO pricing and returns to initial investors *after* the IPO. Contrary to dominant theories in the academic literature, this association is independent of new information produced during the roadshows. High ball IMPREs generate more IPO proceeds than low ball estimates. Given the empirical link between low ball IMPREs and diminished IPO proceeds, why do more than half of issuers in the data set pursue a low balling strategy? Using difference-in-difference analysis, I do not find support for the claim that improving the information set available to issuers at the time they file their IMPRE improves the accuracy of these estimates. My results are better explained if some issuers fail to identify

*Associate Professor of Law, Notre Dame Law School. For thoughtful comments, I am grateful to Maria Macia, Ben Matthies, and participants at the Notre Dame Law School Junior Faculty Workshop. Henry Lay, Andrew McKinley, and Theresa Yuan provided excellent research assistance. My email address is pcorrig3@nd.edu.

the high-balling strategy as the optimal one and instead follow the conventional advice from investment bankers to "start low on valuation to drive deal momentum."

1 Introduction

Regulation S-K requires companies pursuing an initial public offering (IPO) to file a "bona fide estimate of the range of the maximum offering price" (the initial maximum pricing range estimate, or IMPRE) before circulating a preliminary prospectus to investors. The IMPRE decision has thus far been neglected by academics. Does starting the roadshows with a low ball IMPRE maximize proceeds to issuers by driving deal momentum? Or does starting with a low ball IMPRE instead anchor pricing negotiations near the estimated level, making it more difficult for issuers to bargain the initial offering price up to its market value?

One of the seminal and most robust findings in the empirical literature on IPOs is the partial adjustment phenomenon: the greater the pricing revisions from the IMPRE, the greater the expected first-day return for subscribing investors in the IPO (Hanley (1993), Loughran Ritter (2002)). To date, scholars have believed that this relationship is driven by information produced by investors during the roadshows. In one explanation, underwriters leave money on the table by intentionally underpricing IPOs as compensation to investors in exchange for revelation of positive valuation information relative to the IMPRE (the investor compensation theory, Benveniste and Spindt (1989)). In another explanation, managers with biases described by prospect theory vary their bargaining intensity for the ultimate IPO price depending on whether information produced during the roadshows suggests that the manager's wealth is unexpectedly increasing or unexpectedly decreasing (the prospect theory, Loughran Ritter (2002)).

I identify and investigate a third possible explanation: low ball IMPREs are sticky in the sense that they anchor bookbuilding processes and IPO negotiations at the estimated price level. Some combination of information and incentive problems make it difficult for issuers utilizing the traditional firm commitment and bookbuild-

ing IPO process to move the price level above the initial estimate.

The paper makes two main contributions. First, I use instrumental variable analysis to show that strategic decisions about low or high balling IMPREs, which are made *weeks before* IPO pricing, affect IPO pricing and initial returns returns for IPO investors in secondary trading markets *after* the IPO. This relationship is independent of information produced by investors in the roadshows, and is not predicted by information-based theories of IPO pricing. Second, I use difference-in-difference analysis to demonstrate that Congressional reforms from 2012 that improved the information set available to issuers about valuation and investor demand did not improve the accuracy of IMPREs or ultimate IPO pricing.

According to some practitioners, determining the valuation of an IPO company is, at least in part, an "art" (Wilson Sonsini (2016)). An artistic approach stands in tension with the game-theoretic approaches of mechanism design and auction theories, winners of the Nobel Prize in Economics in 2007 and 2020 respectively, which broadly study the mechanisms and strategies available to sellers or buyers given problems associated with incentives and private information. Mechanisms for sellers are typically evaluated according to their ability to maximize sales proceeds and to allocate items efficiently in the sense that the item is allocated to the person who values it the highest.

In discussions with practitioners, the common advice from at least some investment bankers is that issuers should "start low on valuation to drive deal momentum." One practitioner has stated that: "a successful IPO should ideally be priced in the upper quartile of the price range." (Espinasse (2014)). This low balling advice has been internalized by at least some issuers and their venture capital investors. For example, Scott Kupor and Alex Rampell from Andreesen Horowitz have suggested that "the profit-maximizing strategy is to set the price lower at the initial filing range to generate demand (and minimize any concerns around valuation) and then benefit from the increased demand to walk-up the price over the course of the marketing process" (Scott Kupor Alex Rampell (2020)).

My analysis, however, shows that this latter claim is empirically inaccurate, and

the conventional advice from investment bankers is bad advice for price-sensitive issuers. Instead of driving deal momentum, IMPREs appear to anchor IPOs at the estimated price level.

The empirical analyses in this paper employ a dataset of 735 IPOs, the universe of commercial IPOs between 2010 and 2015.

The results establishing non-neutrality of IPO proceeds between low- and high-balling IMPRE strategies are robust. Issuers that pursue an ascending-bid bookbuilding process by low balling their initial estimates are associated with unconditional mean first-day IPO returns of more than 33%. Such high initial returns suggest that, on average, sufficient demand existed to price these IPOs higher, but the bookbuilding process and IPO negotiations failed to obtain such a result. In contrast, issuers that pursued a descending-bid bookbuilding process by high balling their initial estimates are associated with mean first-day returns of less than 1%– indicating that the IPOs were, on average, priced very close to the full information trading.

I isolate the effect of the low-balling / high-balling strategy on IPO returns from the effect of other factors that may be associated with the IMPRE by exploiting variation in registration fee calculation method decisions. The fee calculation decision in the pricing range prospectus, which is made *before* the roadshows, tells us nothing about information produced during the roadshows or the quality of the issuer's business. However, it may reveal something about the issuer's expectations about future pricing revisions in the IPO. Holding the number of offered shares constant, it is optimal (because it minimizes expected fees) for issuers to file under Rule 457(a) if they expect positive pricing revisions during the roadshows. Holding the number of offered shares constant, issuers minimize fees by filing under Rule 457(o) if they expect negative pricing revisions during to the roadshows.

Using OLS regression analysis, I estimate that IPOs with issuers that file under Rule 457(a) *before the roadshows and more than two weeks before the IPO* are associated with 9% more IPO underpricing than IPOs with issuers that file under Rule 457(o). This relationship is statistically significant at the 1% level and it is not pre-

dicted by any prior theory of IPO pricing. For the average IPO, the point estimate suggests that an issuer could obtain $22.5 million more IPO proceeds merely by calculating their registration fees under Rule 457(o) rather than under Rule 457(a).

The fee calculation method is correlated with pricing revisions, and serves as a strong instrument in my instrumental variable analysis. The intuition is that issuers that intentionally low ball (high ball) the initial pricing range are likely to have positive (negative) pricing revisions by construction of the low-balling / high-balling strategy. Moreover, the fee calculation method decision is not correlated with information produced during the roadshows (because it is made before the roadshows occur), and is not likely to be correlated with other omitted variables. Other than through its association with a low ball or high ball strategy, the fee calculation decision does not plausibly affect IPO pricing or aftermarket returns.

Using two-stage least squares instrumental variable estimation, I find that the seminal partial adjustment result–the association between pricing revisions and first-day returns–is at least in part due the issuer's low-balling or high-balling strategy. Low balling the IMPRE is associated with substantially less IPO proceeds than high balling it.

What, then, explains how issuers make the IMPRE decision? Are issuers attempting to proved unbiased estimates but their attempts are inexorably shaped by information asymmetries, as implied by the investor compensation and prospect theories? Or do the decisions reflect strategic actions by underwriters or investors to gain a bargaining advantage? I test the unbiased estimate theory and find it lacking. Under this theory, issuers aim to submit an *unbiased estimate* of the expected final IPO offering price, but the lack of information available to them often makes these estimates inaccurate. Because they treat the IMPRE decision as exogenous to IPO pricing, the investor compensation and prospect theories implicitly take the unbiased estimate view.

Besides constituting a violation of the instructions in Regulation S-K to submit a bona fide estimate of the *maximum* estimate of the range of the price per share in the IPO, the unbiased estimate theory is not supported by the data. I find that

IMPREs are not sensitive to changes in the information set available to issuers and underwriters at the time IMPREs are made. To make this showing, I exploit an exogenous shock to the information set available to issuers and their advisors at the time they file IMPREs.

The 2012 Jumpstart Our Business Startups Act (JOBS Act) permitted certain emerging growth companies (EGCs) to engage in "testing-the-waters" (TTW) communications with certain sophisticated investors, communications which had previously been prohibited by the gun-jumping rules of the securities laws. So, prior to April 2012, issuers had to make decisions about the IMPRE based solely on conversations with their underwriters and other advisors. After April 2012, issuers could make this decision after consulting with the world's largest and most sophisticated investors about their valuation estimates and demand information. If IMPREs are sensitive to the information environment, then the accuracy of IMPREs and ultimate pricing should improve for the "treated" EGCs after the JOBS Act relative to the control group of non-EGCs. Using difference-in-difference analysis, I show that the ability to engage in TTW communications has no distinguishable effect on IMPREs or ultimate IPO pricing outcomes for the treatment group. These results constitute the first empirical evaluation of the effect of TTW communications on IPO pricing, and suggest that the Congressional reforms did not achieve Congress's objective of helping valuation estimates or ultimate pricing outcomes in IPOs.

Given that so many IPOs are underpriced, and given the direct empirical link I establish between low balling IMPREs and IPO underpricing, why do more than half of all issuers in my data set low ball their initial pricing range? One possibility is that issuers are not aware of or do not account for the fact that low balling the IMPRE is an inferior strategy to high balling it. My findings are consistent with the behavioral theory of IPO pricing I have set forth in other work (Corrigan, 2019): some issuers, but not all of them, are naive in the sense that they fail to backwards induce the optimal high-balling strategy that maximizes IPO proceeds. It should not be surprising to observe "naive" issuers with respect to the IMPRE decision. To my knowledge, this paper is the first to establish the non-neutrality of low- and

high-balling strategies. As evidenced by the Kupor and Rampell quote above, there is a mistaken but widespread belief, internalized by at least some key investors in IPO firms, that low balling the initial pricing range is the "profit maximizing" strategy. Moreover, under the behavioral theory, underwriters and institutional investors have incentives to exploit the systematic mistakes of naive issuers, such as by steering them to sub-optimal strategies in the bookbuilding process. Consistent with these incentives, the advice from investment bankers is to pursue the low-balling strategy that is empirically associated with lower IPO outcomes. In the absence of countervailing evidence, which has not previously been available, it would be reasonable for issuers to follow the advice of their underwriters.

What do the results in this paper mean for price-sensitive companies contemplating a going public transaction? The results lend support to detractors of traditional IPOs who suggest that superior mechanisms to bookbuilding exist for IPOs. At its core, bookbuilding provides a self-interested party (the underwriter) a monopoly over pricing and allocation decisions. Mechanisms that use competition to price and allocate the issuer's shares should be expected to deliver more revenue to issuers and to allocate shares more efficiently to higher-value holders. Price-sensitive issuers may consider using alternative pricing mechanisms in going public transactions, including direct listings, Dutch auctions, and dual-track merger processes, including reverse IPOs through a special purpose acquisition corporation.

Issuers that decide to undertake a traditional firm commitment and bookbuilding IPO should strategically high ball the IMPRE if their goal is to maximize IPO proceeds. The caveat is that, while my data set contains nearly equal numbers of high balled and low balled IPOs, my empirical results alone cannot rule out the possibility that starting high on price creates a higher risk of withdrawing the IPO entirely.[1]. Issuers should also hire independent financial advisors, separate from their underwriters, to advise them on the IMPRE–presently, a relatively rare practice in U.S. IPOs.

[1] "Investment banks will generally insist on keeping full momentum during the course of a[n IPO] transaction on the premise that 'time kills deals'." (Espinasse (2014)

Finally, the SEC might consider ways of improving compliance with Regulation S-K, Item 501. The rule requires issuers to submit a bona fide estimate of the range of the *"maximum"* price per share. However, 180 IPOs in the data set, or about a quarter of all IPOs in total, price *above* the high end of the initial pricing range, a rate that can be plausibly attributed to information asymmetries only if issuers and underwriters are not truly attempting to provide a "maximum" estimate. Notwithstanding above range pricing, this group of IPOs with low ball IMPREs still had mean first-day returns of 44%.

2 Literature Review

How do, and how should, companies undertaking U.S. IPOs think about the decision to circulate an IMPRE as required by SEC regulations? And how are pricing revisions relative to the IMPRE through IPO pricing related to IPO pricing and aftermarket trading returns? While the former question is relatively unaddressed, a large literature addresses the latter question.

2.1 The Classic Partial Adjustment Result and Models of the IPO Pricing Decision

The most seminal and robust finding in the empirical literature on bookbuilding is that pricing revisions during the roadshows are positively associated with first-day returns: the more the issuer revises its price upwards from the start of the roadshows to the final IPO offer price, the more IPO underpricing in the aftermarket (Hanley (1993)).

Pricing revisions are consistently the variable with the most explanatory power for initial returns of IPOs. I replicate this result with my own dataset, showing that the relationship holds for U.S. IPOs between 2010 and 2015.[2]

Pricing revisions are calculated as the percentage change from the midpoint of the

[2]See columns 1 and 2 of Table 5 and the discussion below.

IMPRE to the initial offering price in the IPO. The IMPRE is typically submitted before the roadshows more than two weeks before the IPO and the initial offering price is usually negotiated the night before the offering occurs.

The robust partial adjustment phenomenon remains puzzling. Why should pricing revisions *before* the IPO is priced predict stock price movements in secondary markets *after* the IPO? Two dominant theories purport to explain the relationship between pricing revisions and aftermarket returns: the investor compensation theory and the prospect theory.

The investor compensation theory of Benveniste and Spindt (1989) argues that underwriters intentionally underprice IPOs following positive pricing revisions, leaving some money on the table for investors, as compensation to those investors in exchange for honest revelation of their private information related to demand for the issuer's stock. The basic problem in the model relates to the incentives of investors to reveal private demand information. Why would investors communicate good information when it just means they would have to pay a higher price in the IPO?

Benveniste and Spindt argue that, in a repeat game, the equilibrium outcome is for investors to reveal their truthful demand information while underwriters leave some money on the table as a quid pro quo for the information revelation. This relationship, it is sometimes said, indicates that underwriters only "partially adjust" IPO prices upwards (but fully adjust them downwards to incorporate negative information revealed by investors).

One unsatisfactory aspect of the investor compensation theory is that it fails to explain why individual issuers are willing to accept higher than necessary IPO underpricing. Loughran and Ritter's prospect theory (2002) explains both the positive association between pricing revisions and IPO initial returns and why issuers fail to bargain for market value in their IPOs.

Prospect theory, as applied to IPOs by Loughran and Ritter, suggests that agents of the issuing company place excessive weight on *changes* to their wealth, and excessively discount the absolute level of their wealth. When initial pricing estimates

are unexpectedly revised downwards, the manager bargains fiercely for a high IPO price in order to prevent downward changes to their wealth. On the other hand, when prices are unexpectedly revised upwards, the issuer's managers are more likely to acquiesce in leaving money on the table in the IPO.

2.2 Models of the Entire Bookbuilding Process

An unsatisfactory aspect of both the investor compensation and prospect theories is that they take the IMPRE as exogenous to ultimate IPO pricing. Under both theories, issuers leave money on the table only when they submit a low ball IMPRE, so why don't issuers anticipate this outcome and submit a high ball IMPRE that will not foreseeably lead to them leaving money on the table in their IPO?

If IMPREs are strategic decisions that are endogenous to IPO pricing outcomes, then prior empirical analyses about pricing revisions may have suffered from a crucial omitted variable: the decision about the initial estimate itself. An important empirical question is, therefore, whether the observed relationship between pricing revisions and first-day returns is driven by information production during the roadshows or by strategic response resulting from low balling or high balling the IMPRE decision.

Unlike in the investor compensation theory and the prospect theory, the behavioral theory of IPO pricing (Corrigan 2019) treats decisions during the bookbuilding process, including the IMPRE, as endogenous to ultimate IPO pricing. Under the theory, issuers are either sophisticated–the standard rational, profit-maximizing economic agents–or naive in the sense that they fail to backwards induce optimal strategies to their transactional vulnerability in IPOs. In equilibrium, underwriters exploit the predictable biases of naive issuers by underpricing their IPOs and use the underpricing rents to cross-subsidize the IPOs of sophisticated issuers. Competition among underwriters exacerbates rather than resolves the exploitation problem. As applied to the classic partial adjustment result, the behavioral theory of IPO pricing would suggest that sophisticated issuers pursue the dominant strategy of high

balling the IMPRE, while naive issuers pursue the dominated strategy of low balling the IMPRE.

2.3 Applied Auction and Mechanism Design Theory

This paper contributes to the vast literature on applied auction theory and mechanism design theory.

In full information settings with no transaction costs or agency costs, it is relatively easy for sellers to maximize revenue and to efficiently allocate items for sale. Indeed, a seminal finding in the literature is that, in this context, Dutch auctions, English auctions, and sealed bid auctions generate identical revenue and allocation outcomes (Vickrey (1961, 1962), Myerson, (1981)).

Developments in auction theory and thoughtful applications of its precepts have, in certain cases, improved on the sales processes and outcomes that previously prevailed in markets. Among other contexts, thoughtful mechanism design by transactional planners and academics may matter when investor's valuations of the item(s) for sale are affiliated or when bidders or intermediaries may cooperate to maximize their private payoffs.

Optimal mechanisms have been theoretically described in the IPO context. Baron (1982) studied a context in which underwriters faced an agency conflict because their effort and other costs in marketing and underwriting the issue decrease with expected IPO underpricing, and found that this effort problem could be ameliorated by providing underwriters with optimal incentive-based compensation contracts. Biais et al. (2002) studied an optimal mechanism in a setting in which investors have private information about the market valuation of the shares, the underwriters have private information about the demand, and the investors and underwriters collude, and found that a particular auction mechanism resembling a Dutch auction was the optimal mechanism. Ausubel (2002) focused on the problem of affiliated information among bidders and found that an ascending-bid, multi-unit auction format provides revenue and allocation efficiency advantages over the sealed-bid, multi-unit

auction format that bookbuilding resembles. Sherman (2000) and Sherman and Titman (2002) concluded that the traditional bookbuilding process may improve on outcomes of more conventional auction formats when certain conditions apply, including when entry into IPO bidding by investors is endogenous and costly.

I am aware of no scholarly work which, taking the traditional firm commitment and bookbuilding IPO mechanism as a given, analyzes decisions issuers face in the bookbuilding process *before* the ultimate IPO pricing decision, as I do in this work.

3 Data

The sample of IPOs is collected from Thomson Reuters Securities Data Company (SDC) Platinum Global New Issues Database. I collect data for all U.S. IPOs between 2010 and 2015. Consistent with prior studies in the literature on IPOs, I exclude offerings of small issuers (proxied by deals with offer prices below $5 per share), closed-end-funds, real estate investment trusts, banking entities, and offerings that are not common stock offerings, including American Depositary Receipt offerings, unit offerings, and certain limited partnership offerings. I also exclude issuers that had previously traded on a foreign exchange, bulletin board, or the pink sheets before their IPO. The final sample includes 735 unique IPOs containing the population of U.S. commercial IPOs over that time period.

I obtain issue-specific information from SDC Platinum including the offering price per share, the total number of shares offered in the IPO, the issuer's revenue in the last financial year, and similar information.

I obtain security price information about the issuer's stock from the Center on Research of Security Prices.

For each IPO, I collect information from four SEC filings: the initial filing of the registration statement on Form S-1, S-1 amendments, the final prospectus associated with the IPO filed pursuant to Rule 424(b), and any post-offering 462(b) filings for the purpose of registering additional shares.

For each IPO, I hand-collect the very first pricing range estimate in the initial

pricing range prospectus and the last pricing range estimate at the moment when the SEC declares the registration statement effective. I collect registration fee calculation information at the initial S-1 filing, at the first pricing range prospectus, and at effectiveness. I also hand-collect data on the registration of additional shares after effectiveness of the registration statement, deemed immediately effective pursuant to Rule 462(b)(3). Finally, I hand-collect data about ownership of the issuer before the IPO and selling participation in the IPO from insiders and 5% stockholders.

Table 1 reports certain descriptive statistics for the data set.

[TABLE 1 HERE]

4 Conceptual Framework and Descriptive Mapping of the Bookbuilding Process

Prior studies about IPOs in the academic literature have typically focused on a single decision: the final IPO pricing decision. My analysis reveals that issuers are faced with a much richer set of decisions during the bookbuilding process before the IPO–some made weeks or even months before the IPO.

Figure 1 models the bookbuilding process and emphasizes four decisions key decisions that issuers face during the bookbuilding process, roughly corresponding to three time periods. Each period of the bookbuilding process is fraught with regulatory requirements. Rules that are relevant to the bargaining game analyzed in this paper are also identified in Figure 1.

[FIGURE 1 HERE]

Throughout this paper, I assume that the objective of issuers undertaking IPOs is to maximize their proceeds. This assumption is derived from the standard assumption that issuers are economic agents that desire to maximize their financial payoffs.

At Time 1, the issuer makes its first public filing of a draft registration statement on Form S-1. In the pre-circulation period after Time 1 and before Time 2,

the underwriter conducts due diligence and acquires valuation information about the issuer. This period is dominated by a review of documents and conversations between the underwriters and the issuer's managers and key employees. After April 5, 2012, it may also include testing-the-water communications between the issuer or underwriters with large, sophisticated investors.

At Time 2, the issuer files the IMPRE–the first S-1 amendment with a preliminary prospectus that includes a "bona fide estimate" of the range of the maximum offering price and number of shares offered in the IPO. IMPREs are required under SEC rules before issuers may circulate a prospectus to potential investors. This filing kicks off the roadshow period, in which the issuer's managers typically go on a blitz campaign of one-on-one meetings with large institutional investors and other important potential purchasers of the issuer's stock. In connection with these bilateral meetings and other conversations, underwriters collect an informal "book" of information about the demand for the issuer's stock from investors.

At Time 3, the issuer seeks effectiveness of the registration statement from the SEC. This filing begins the pricing negotiation period. Effectiveness is required under the securities laws before the issuer can sell the offered shares in the IPO. After receiving effectiveness, the issuer negotiates with the underwriters to determine the initial public offering price and the number of shares offered. The agreement of both parties is necessary to a traditional firm commitment IPO occurring. The IPO pricing negotiation between issuers and underwriters is conducted under the shadow of SEC Rule 430A which prevents issuers from making post-effective changes to the bona fide estimates of the offering price and number of shares offered outside of certain 20% and materiality thresholds.

Table 2 provides the first presentation in the academic literature of mean variables at the three periods of time identified in Figure 1, which illustrates the richness of the decision set of issuers in the bookbuilding process.

[TABLE 2 HERE]

5 How "Accurate" Are IMPREs?

Regulation S-K Item 501 requires that any circulated prospectus must set forth on the front cover page of the prospectus a "bona fide estimate of the range of the maximum offering price and the maximum number of securities offered."[3] I call the first S-1 amendment that contains such a bona fide estimate the "initial pricing range prospectus."

One effect of the requirements in Regulation S-K Item 501 is that issuers must file the initial pricing range prospectus before commencing their marketing efforts on the roadshows. On average in my dataset, issuers file their first pricing range prospectus 17 days before the actual IPO.

I calculate two measures of the accuracy of the IMPRE, one in reference to the ultimate IPO offer price and the other in reference to issuer's stock price at the end of the first-day of secondary trading. In constructing these measures, I use the following notation:

P_0 equals the midpoint of the IMPRE and is calculated as the high price plus the low price of the IMPRE all divided by 2;[4]

P_1 equals the IPO offer price; and

P_2 equals the price of the issuer's stock at the close of the first day of trading.

Percentage Revisions The variable *Per. Revision* is calculated as $(P_1 - P_0)/P_0$.

Issuers in IPOs with a positive *Per. Revision* value low balled their IMPRE relative to the actual IPO price. Issuers in IPOs with a negative *Per. Revision* value high balled their initial pricing estimate relative to the actual IPO price.

I interpret pricing revisions as a descriptive measure of the error of the initial estimate in reference to the ultimate IPO offering price. *Per. Revisions* represents the distance that the issuer travels during the bookbuilding process from the IMPRE

[3]The SEC staff generally require a bona fide pricing range to not exceed $2 for maximum prices below $10 per share, and 20% of the maximum price per share for prices per share above $10 per share

[4]I use the midpoint of the IMPRE to be consistent with how pricing revisions are traditionally measured in the empirical finance literature. *See, e.g., Hanley (1993), Loughran and Ritter (2002).*

to the final IPO offering price.

Fair Market Value Error The variable *FMV Error* is calculated as $(P_2 - P_0)/P_0$.

This variable measures the error of the IMPRE in reference to a proxy for the fair market value of the issuer's stock price–the first-day closing price of the issuer's stock. The assumption is that the fair market value does not change from the time the IMPRE is made until the end of the first day of trading. The sign on the *FMV Error* indicates whether the issuer low balled (a positive sign) or high balled (a negative sign) the estimate relative to market value.

I think of the *FMV Error* variable as a proxy that measures the distance, as a percentage of the issuer's revealed stock price, that an issuer has to cover during the roadshows and pricing negotiation in order to adjust their IMPRE all the way to the first-day trading value of the issuer's stock price.

Figure 2 plots the *Per. Revision* variable for all 735 IPOs in the data set and Figure 3 plots the *FMV Error* variable. Dots above 0% indicate that issuers in these IPOs submitted a low-ball IMPRE. Dots below 0% indicate that the issuers in these IPOs submitted a high-ball estimate.

[FIGURES 2 AND 3 HERE]

If issuers attempt to submit unbiased IMPREs, then IMPREs are biased across the population. The mean value of *FMV Error* is 13.6%. The mean value of pricing revisions is -5%. IMPREs are also not very accurate under the unbiased estimate assumption. The mean absolute value of the *FMV Error* variable is 35.2%, while the mean absolute value of pricing revisions, is 17.6%.

If issuers attempt to submit a *maximum* pricing range estimate, as required under the instructions to Item 501 of Regulation S-K, many issuers mistakenly err by submitting low ball IMPREs. One quarter of all IPOs in the data set eventually price the IPO *above* the high end of the IMPRE, with mean pricing revisions in this subgroup of more than positive 20% and mean first-day returns in excess of 43%.

The color of the dots in Figures 2 and 3 provide a visual test of the bivariate relationship between the two measure of IMPRE errors and first-day returns of

IPOs in the aftermarket. IPOs that are underpriced–those with positive first-day returns–are shaded in dark blue. IPOs that are overpriced–those with negative first-day returns are shaded in light blue.

There is a clear visual relationship between initial estimates and aftermarket returns. Light blue dots cluster under the red line and are rarely seen above the red line–particularly when the IMPRE is low balled in the Figure 3 plotting the *FMV Error* variable–while dark blue dots are more frequently observed above the red line. For example, the data visualized in Figure 3 and described in Table 3 reveals that only 3.8% of the IPOs in my data set with low ball FMV Errors–IPOs in which *FMV Error* is above 0–ultimately price their IPO at or above the first-day closing price. IPOs with high ball initial estimates–those with FMV errors less than 0–on the other hand, succeed in pricing their IPOs at or above the first-day closing price 54.5% of the time.

Tables 3 and 4 split IPOs in the data set into groups based on whether they low ball or high ball percentage revisions and FMV errors respectively. The table reports the number of IPOs in each group, the percentage of IPOs in each group that price the IPO at or above market value, and the mean first-day returns associated with each group.

[TABLES 3 AND 4 HERE]

Tables 3 and 4 demonstrate a substantial unconditional relationship between low balling IMPREs and first day returns. IPOs in which issuers "start low on valuation" by submitting an IMPRE below the ultimate IPO deal price are associated with mean first day returns of 36.1%. IPOs in which issuers instead submit an IMPRE above the ultimate IPO deal price are associated with mean first day returns of 3.6%. IPOs in which an issuer submits an IMPRE that low balls the proxy for its full information value are associated with mean first day returns of 32.5%, compared to mean first-day returns of 0.5% in IPOs in which the issuer high balls the IMPRE.

At this stage, some readers may be wondering whether the bivariate relationships in Figures 2 and 3 are due to the IMPRE errors themselves or due to new information produced after the initial estimates are filed, as the prior literature has suggested.

The next section turns to this question.

6 Does the IMPRE Affect IPO Pricing and Aftermarket Returns?

6.1 Replicating and Revisiting the Classic Partial Adjustment Result

I replicate the partial adjustment result, showing that the IPOs in my data set between 2010 and 2015 exhibit a positive association between pricing revisions and first-day returns.

I estimate regressions of the form:

(1)

$$Y_i = \beta_2 X_i + \sigma + \mu$$

Where Y_i, the dependent variable, measures the first-day return of firm i. The first-day return is defined as $(P_2 - P_1)/P_1$, or the difference between the first-day closing price of the issuer's stock and the IPO offer price as a percentage of the IPO offer price. Consistent with the prior literature on IPO underpricing, the determinants of the first-day return are assumed to be a vector of control variables associated with each firm, X_i; year dummies; σ; and an idiosyncratic error, μ. Control variables include log of book assets before the IPO; net-income before the IPO; the CRSP equal-weighted market return for the twenty-one trading days prior to the IPO; the value of the volatility index on the night before the IPO; whether the IPO has venture capital backing; the amount of primary shares offered in the IPO as a percentage of all shares outstanding after the IPO; and the ratio of secondary shares offered by insiders to the total number of shares offered in the IPO.

The vector of controls also includes year fixed effects which allows the regressions to absorb unobserved variation across calendar years. All reported standard errors

in this paper are robust.

Table 5 presents the results.

[TABLE 5 HERE]

In specifications 1 and 2, the coefficient on *Per. Revisions* is positive and highly significant, consistent with prior studies finding this association. A 1% increase in percentage revisions is associated with a 0.64% increase in first-day returns.

Prior studies have largely interpreted the positive association between pricing revision and aftermarket returns as evidence that information production during the roadshows acts on first day returns in some manner.

Unlike prior studies, I do not assume that the IMPRE to is exogenous to ultimate IPO pricing. If IMPREs independently act on first day returns in some manner, then the regression estimates in columns 1 and 2 of Table 5, as in the prior academic literature may be biased.

As an initial test, consider the opposite assumption as the one made by the existing literature. Assume that information production during the roadshows is exogenous to IPO pricing and aftermarket trading. The best interpretation of the positive coefficient on *Per. Revision* under this assumption is that some combination of information or incentive problems cause the IMPREs to be sticky in the sense that it is difficult for issuers, underwriters, or investors to move away from the IMPRE towards the full information value.

In column 3 of Table 5, I replace the percentage revisions variable with a dummy variable that equals 1 if for IPOs with positive pricing revisions and 0 for IPOs with negative or zero pricing revisions. The low-balling dummy should be a weaker proxy for information production by investors during the roadshows than the precise percentage revisions variable. Under the information production explanation–and especially if one's theory is that starting low on valuation to drive deal momentum maximizes IPO proceeds–one might expect the *Lowball* dummy to be statistically and economically insignificant. Nevertheless, the point estimate on the coefficient suggests that the action of low balling the IMPRE relative to the ultimate IPO offer price is associated with *31.2%* greater IPO proceeds than high-balling it. The

association is highly significant at the 1% level.

The key empirical question, therefore, is the following: does the relationship between IMPRE errors and first-day returns result from the information produced during the bookbuilding process, or from features of the negotiation process itself, independent of information production?

6.2 The Instrument: The Choice of Registration Fee Filing Method

This Section attempts to address the pricing revision endogeneity problem by identifying variation in the issuer's negotiation strategy that is orthogonal to information produced during the roadshows.

The identification strategy is possible if some instrument for pricing revisions exists that acts on first-day returns through the issuer's negotiation strategy but *not* through the information produced in the roadshows, and otherwise has no direct effect on aftermarket returns.

To isolate the effect of the negotiation set up from information produced during the roadshows, I use the issuer's choice of filing method for calculating the registration fees owed to the SEC in the initial pricing range prospectus as an instrument for pricing revisions and market value errors of IMPREs. The filing fee method is motivated by fee minimization considerations, which in turn depend on the issuer's expectations about likely pricing revisions during the roadshows and IPO pricing negotiation.

The understanding that the fee calculation decision reflects expectations about future pricing revisions is confirmed by IPO practitioners. For example, a leading law firm in the IPO space, Latham Watkins, has written that "[m]any deal teams elect to switch to Rule 457(a) at the time of printing the price range prospectus because increasing the price per share at pricing is a more likely outcome than increasing the number of shares and decreasing the price."

Since the fee calculation decision is made before the roadshows, it can be stated

with certainty that the decision is exogenous to new information produced by investors during the roadshows.

The registration fees owed to the SEC in an IPO are calculated by multiplying the *aggregate offering amount* by a constant, currently 0.0001091 ($109.10 per $1 million raised). In the mean IPO with proceeds of $252 million, the filing fees for this amount of proceeds would be around $27,533. Nothing to sneeze at, and certainly worth minimizing, but generally not significant enough to drive an issuer's bargaining strategy in a major financial transaction.

To determine the aggregate offering amount, which forms the basis of the fee calculation, the issuer has a choice of methods. Under Rule 457(a), the issuer may calculate the registration fee according to the number of shares to be registered multiplied by a bona fide estimate of the maximum offering price for a given number of shares. Under Rule 457(o), the issuer may calculate the fee on the basis of an estimated maximum aggregate offering price of all the registered securities.

The fee calculation table is a required item on Form S-1, the form of registration statement under the Securities Act of 1933. Issuers can change their fee calculation method at any time prior to effectiveness by filing a pre-effective amendment.

For each IPO, I collect the filing fee method in the initial public S-1 filing, the first pricing ranging prospectus, and the prospectus at effectiveness. For each time period, I code a dummy variable as 1 if the issuer calculates registration fees under 457(a) and 0 if the issuer calculates fees under Rule 457(o).

As reported in Table 2, more than 99% of issuers file under 457(o) in the initial S-1 filing, which requires issuers to calculate registration fees on the basis of an estimated aggregate offering size. The received wisdom for filing under 457(o) from practitioners is that issuers do not want to tip off the market about their expected price per share until they are required to do so. The reason for this coyness is not self-evident, but appears to be nearly universally followed.

When the IMPRE is required pursuant to Regulation S-K Item 501 just before the roadshows, 68% of issuers switch to calculating their fees under Rule 457(a), which requires issuers to estimate filing fees for a specified number of registered

shares on the basis of a bona fide estimate of the maximum offering price.

6.3 Instrumental Variable Specifications

My first-stage and reduced-form specifications, respectively, are:

(2)

$$E_i = \beta_1 Z_i + \beta_2 X_i + \sigma + \mu$$

(3)

$$Y_i = \beta_1 Z_i + \beta_2 X_i + \sigma + \mu$$

Where, in the first-stage, E_i is a measure of the IMPRE error. I test both measures of IMPRE error: *Per. Revision* and *FMV Error*. Z_i represents each issuer i's decision to calculate registration fees under Rule 457(a) or Rule 457(o) in the first pricing range prospectus. Other independent variables include, as described in connection with equation (1) above, a vector of control variables associated with each firm, X_i; year dummies; σ; and an idiosyncratic error, μ.

6.4 Instrument Validity

To be a valid instrument for each of *Per. Revision* and *FMV Error*, the registration fee calculation decision must be correlated with each of *FMV Error* and *Per. Revision* (the strength of the instruments) and must be unrelated to omitted variables (the exclusion restriction).

Correlation with Initial Pricing Range Estimate Error and Percentage Revisions

If the goal is to minimize the registration fees that they pay, issuers face a backwards induction problem when deciding to file between 457(a) and 457(o). The optimal filing decision will turn *solely* on the issuer's expectations about the likelihood of changes to the price per share and IPO deal size.

Rational issuers should pick the method that they expect will minimize the fees that they pay. Under Rule 457(a), the issuer only pays additional fees if the number of shares to be offered is increased by an amendment prior to the effective date. No additional fees are owed if the number of shares stays the same but the price per share increases. Under Rule 457(o), the issuer only pays additional fees if the maximum aggregate offering price of all the securities registered in that offering increases. No additional fees are owed if the issuer maintains the same IPO deal size or reduces the IPO deal size.

The instrument should, therefore, reflect something about the issuer's expectation of likely pricing revisions and should thus be strongly correlated with pricing revisions and FMV errors.

The fee registration calculation is keyed to the IPO deal size–a combined measure of the number of shares registered and the price per share. Thus, when issuers are uncertain about the number of primary shares that they want to register at the time the IMPRE is made, the optimal fee calculation method may not be obvious. However, when issuers have certainty about the percentage of the firm's stock that they want to offer, the fee calculation decision will turn *solely* on expectations about future pricing revisions.

Thus, if issuers are rational and pay attention to the fee calculation decision, then IPOs with issuers that decide to file under Rule 457(a) should be associated with greater pricing revisions and FMV errors than IPOs with issuers that decide to file under Rule 457(o).

As expected, issuers file under Rule 457(a) more frequently (82.8% of the time) when the IPO has positive pricing revisions than when the IPO has negative pricing revisions (60.1% of the time).

Table 6 presents the unconditional difference in means for each of the *FMV Error* and *Per. Revisions* in IPOs filed under 457(a) and 457(o). In a two-tailed T-test, the differences in means are significant at the 1% level.

[TABLE 6 HERE]

Exclusion Restriction

The instrument also very likely meets the exclusion restriction. This conclusion is particularly strong in the narrow sense that the instrument is not correlated with the potential omitted variable that drives the investor compensation and prospect theories: new information produced during the roadshows.

The filing method decision must meet the exclusion restriction with respect to the possible omitted variable of information production in the roadshows because the fee calculation filing decision occurs *before* the roadshows and before a preliminary prospectus is circulated. The filing method decision therefore can tell us something about the issuer's negotiation strategy, but it cannot tell us anything about the information produced during bookbuilding process.

An argument can be made that the instrument meets the exclusion restriction more broadly in the sense that the issuer's filing method decision is unlikely to be correlated with the error term at all. This argument cannot be empirically tested. However, there are strong theoretical reasons to believe that the instrument meets the exclusion criteria with respect to all possible omitted variables. The filing fee method is a narrow and technical decision. The objective of issuers is to minimize the expected fees that they pay, and this in turn depends *solely* on the issuer's expectations related to upsizing and downsizing the IPO. Thus, the instrument should meet the exclusion restriction.

Instrument Relevance

The first stage regressions are reported in the appendix in Table 7. Since the coefficients on β_1 are significant below the 1% level in all first stage regressions, the instrument is relevant with respect to both pricing revisions and FMV errors. As shown in Tables 8 and 9 presenting results for the reduced form regressions, the F-statistic is above 10 in all first-stage regressions.

6.5 Results on first-day Returns

I now analyze my reduced form and instrumental variable estimates on the outcome variable of interest: first-day returns after an IPO.

6.5.1 Reduced-Form Effects

The reduced form specification follows the specification in the first stage, but isolates the effect of the instrument on first-day returns, conditional on the same set of controls as in the first-stage estimation.

Two Stage Least Squares To obtain an estimate of the effect of the issuer's low- / high-balling strategy, I scale the reduced-form estimate by the first stage coefficient using a two-stage least square process (2SLS). The 2SLS procedure calculates a coefficient and confidence intervals on the effects on the assumption that all effects operate through the issuer's strategy of low balling or high balling the initial offering price.

Table 8 reports results of the 2SLS estimates in which the IMPRE error is measured by *Per. Revisions*. Table 9 reports results of the 2SLS estimates in which the IMPRE error is measured by *FMV Error*. Column 1 reports OLS regression results. Columns 2 and 3 present the results for specifications in which the filing calculation method instruments for *Per. Revisions* or *FMV Error*.

The effect of measurements of the instrumented variables on first-day returns is positive and highly significant in all specifications.

[TABLES 8 AND 9 HERE]

To further investigate the association between the low balling strategy and first day returns, I run regressions of the form specified in equation 1, but I substitute the fee calculation method dummy for pricing revisions. Table 10 presents the results. The coefficient on the fee calculation method is significant at the 1% level. The coefficient suggests that issuers that calculate their fees under Rule 457(o) *in the pricing range prospectus circulated before the roadshows and weeks before the IPO is priced* should expect to obtain 9 percentage points greater IPO proceeds–almost $23 million in an IPO with average proceeds–than issuers that file under Rule 457(a). Other than through the low-balling or high-balling strategy, there is no reason why filing under Rule 457(a) relative to 457(o) should affect IPO pricing or aftermarket trading.

6.5.2 Discussion of Results

A baseline implication of the results in Tables 8 and 9 is that IMPREs *independently of information produced during the roadshows* affect first-day returns. The instrumented explanatory variables in these tables measure the portion of the estimate error term that is attributable to a decision made *before* information is produced during the roadshows. Thus, the seminal empirical findings relating pricing revisions to first-day returns is attributed, at least in part, to the characteristics of the issuer's negotiation strategy rather than to information produced by issuers.

These results suggest that the investor compensation theory and prospect theory are incomplete explanations for the association between percentage revisions and first-day returns. At a minimum, these explanations fail to account for the IMPRE decision–a decision that significantly influences IPO pricing and aftermarket returns for investors.

The specifications in Table 8 regress first-day returns on a portion of the *Per. Revision* that is not likely to be correlated with the error term. Recall that pricing revisions measure the percentage change from the midpoint of the IMPRE to the ultimate IPO offer price. IPOs with positive percentage revisions are ones in which issuers low balled the IMPRE in relation to the ultimate deal price.

The specifications in Table 9 regress first-day returns on a portion of the *FMV Error* that is not likely to be correlated with the error term. Recall that this term measures the percentage change from the midpoint of the IMPRE to the ex post revealed closing price. So, in the specifications in Table 9, there is a mechanical relationship between the dependent variable and the *FMV Error* explanatory variable. In particular, *FMV Error* will always take a positive value when the dependent variable, the first-day return of the IPO, also takes on a positive value. Thus, the results should be interpreted with this understanding.

In the fully fitted specification, a 1% increase in the instrumented *Per. Revision* is associated with a 1.326% increase in first-day returns. A 1% increase in the instrumented *FMV Error* is associated with a 0.61% increase in first-day returns.

These results show that, at a minimum, some of the effect of pricing revisions on first-day returns is *not* due to information production by investors. Instead, IMPREs anchor subsequent price discovery and IPO pricing negotiations near the IMPRE. Due to some combination of information frictions or agency costs, it is difficult for issuers (or investors) to move away from their initial estimates. Contrary to the conventional advice from investment bankers to start low on valuation to drive deal momentum, starting low instead appears to stagnate deals at a low price. Issuers that start high on valuation obtain substantially greater IPO proceeds than issuers that start low.

7 What Explains Issuer's Decisions Related to the IMPRE?

What, then, explains why more than half of issuers low ball the IMPRE?

One possible explanation is that issuers lack the information necessary to make accurate estimates of their valuation. On it's face, this explanation is more plausible if issuers disregard the instructions in Regulation S-K to submit a *maximum* pricing range estimate, and instead attempt to use the IMPRE to submit an *unbiased* estimate of the ultimate IPO offering price given all the information available to the issuer at the time the estimate is made. The information asymmetry explanation explanation is less plausible if issuers instead follow the instructions of Regulation S-K Item 501 to submit an estimate of the range of the IPO price per share and are simply unable to produce a sufficiently high value.

7.1 Using the JOBS Act of 2012 to Obtain Difference-in-Difference Estimates

The investor compensation and prospect theories implicitly take the unbiased estimate view. Percentage Revisions, according to this view, arise solely because issuers and their underwriters have imperfect information about investor demand for the

issuer's stock at the time the IMPRE is made.

The unbiased estimate view creates a testable prediction: if unbiased IMPREs are a function of information asymmetries, then incremental improvements to the information environment should create incremental improvements to the accuracy of initial estimates. If the initial estimate is instead primarily a strategic decision, as predicted by the behavioral theory of IPO pricing, then increased information will not necessarily improve the initial estimates.

The JOBS Act provides a natural experiment to test the effects of information asymmetries on pre-IPO valuation estimates and on IPO initial offering prices. On April 5, 2012, the newly authorized testing-the-waters (TTW) reforms in the JOBS Act improved the information set available to IPO participants in submitting their IMPRE. I exploit this exogenous shock to the information environment to test the unbiased estimate explanation for IMPREs.

The JOBS Act created a new category of issuers called "emerging growth companies" (EGCs). An EGC was defined as an issuer with total annual gross revenues of less than $1 billion during its most recently completed fiscal year (the threshold was raised to $1.07 billion in 2017 to account for inflation). I created a variable, *EGC*, that equals 1 if the last 12 months revenue before the IPO was less than $1 billion, and 0 otherwise.[5]

The JOBS Act amended Section 5 of the Securities Act of 1933–which generally prohibits communications about a proposed offering before certain filings and disclosures have been made–to add a "testing-the-waters" provision, which permitted an EGC or its authorized representative to engage in oral or written communications with certain qualified investors. This exogenous shock drastically changed the amount of information available to EGCs and their underwriters when making the IMPRE decision. Before June 2012, underwriters had to file the initial bona fide estimate of the maximum price per share in the pricing range prospectus before the roadshows without the aid of any potential investors in the IPO. After April 5, 2012,

[5]The sample with the EGC variable drops to 646 observations because SDC Platinum does not have data related to last 12 months revenue for 89 IPO issuers.

EGCs had the option of discussing the IPO with some of the world's largest and most sophisticated investors before making their initial estimates of the maximum price per share filed in the first pricing range prospectus.

The idea of the difference-in-difference analysis in this context is that EGCs were "treated" by the TTW provisions of the JOBS Act. A valid analysis depends on the assumption that trends between EGCs and non-EGCs with respect to the variables of interest are parallel, so that changes in means between the two groups after the passage of the JOBS Act can be attributed to the passage of the JOBS Act.

There is no theoretical reason to believe that *trends* in valuation or pricing errors between EGCs and non-EGCs would be diverging in the months and years prior to April of 2012. Traditional IPOs employed the same firm commitment and bookbuilding methods they had been using for decades. With the 2008 financial crisis in the rear view mirror, there were no obvious shocks to the market that would disproportionately affect very large IPO companies with more than a billion in revenue over the last twelve months relative to IPO companies with less revenue than that. No major legislation besides the JOBS Act passed and no major rules were written that would differentially affect the valuation of small firms relative to large firms.

To evaluate the parallel trends assumption of the difference-in-difference analysis to follow, Figures 4, 5, 6, 7, and 8 aggregate mean values by year and EGC status for pricing revisions, the absolute value of pricing revisions, FMV errors, the absolute value of FMV errors, and first day returns. The blue vertical line indicates the quarter in which the JOBS Act passed. The trends for in all figures are roughly parallel leading up to the passage of the JOBS Act in April, 2012.

[FIGURE 4 HERE]

I investigate whether errors in estimates of the issuer's valuation decrease following the JOBS Act. Moreover, I use difference-in-difference analysis to investigate whether any such changes in FMV Errors are concentrated in the EGCs that are eligible to use the TTW provisions of the JOBS Act.

I estimate regressions of the form:

$$Y_i = \beta_1 EGC + \beta_2 Post + \beta_3 EGC * Post + \beta_4 X_i + \alpha_i + \mu$$

Where Y_i is dependant variable; X is a vector of control variables associated with each firm i; the α are unobserved heterogeneities across calendar years; and μ is the error term.

EGC is a dummy variable indicating whether a company is had last twelve months revenue of less than $1 billion before the IPO. I use the "last twelve months revenue" data from SDC Platinum to categorize firms as EGCs.

Post is a dummy variable indicating whether the IPO occurred in the post treatment period, that is, after the JOBS Act passed on April 5, 2012.

$ECG * Post$ is the variable that indicates whether a company is "treated" in the sense that they are able to take advantage of the TTW reforms following the JOBS Act. The coefficient for $ECG * Post$ is the difference-in-difference estimator. The coefficient represents the change in in initial error estimates for treated IPOs less the change in initial error estimates for control units.

Table 11 presents the regression results for specifications using *FMV Error*, *Per. Revisions*, and *First-Day Returns* as dependant variables. In unreported results, I run the same difference-in-difference regressions with the absolute value of *FMV Error* and the absolute value of *Per. Revisions*. The difference-in-difference coefficients for $EGC * Post$ are not significant in any of these regressions.

[TABLE 11 HERE]

In some of the parallel figures, there appears to be a change in the relative trends in 2014. The trend break moves in the opposite direction that one would expect if the JOBS Act improved IMPREs and ultimate IPO pricing outcomes. Nevertheless, as a robustness check, I eliminate all observation after 2013 and run the difference-in-difference regressions with the sub sample of IPOs to ensure that an unrelated shock after this time period did not change my results. Again, none of the difference-in-difference coefficients are positive.

As another robustness check, I exclude all IPOs in the second quarter of 2012

on the theory that results might be skewed if issuers were still adjusting to the new reforms around the time of the passage. I find no significant effects for the difference-in-difference variable.

My results constitute the first analysis in the academic literature of the effectiveness of the TTW reforms from the JOBS Act of 2012. I find no evidence to support the conclusion that the TTW provisions in the JOBS Act helped issuers more accurately value themselves in the pre-circulation due diligence period or during the roadshow discussions with investors. I also find no evidence to support the conclusion that the TTW provisions helped issuers price IPOs more accurately or otherwise reduce IPO underpricing.

The visual analysis in Figures 2 and 3 supports the conclusion of the difference-in-difference analysis that the TTW reforms did not improve the accuracy of initial estimate. Figures 2 and 3 suggest that the accuracy of initial estimates *deteriorated* rather than improved across the board after the TTW reforms.

The difference-in-difference results suggest that initial estimates and ultimate IPO pricing are not sensitive to the information environment. The results, therefore, fail to find support for the notion that IMPRE errors result from information asymmetries. If initial deal errors measured by pricing revisions and FMV errors reflected a simple lack of information about the expected value of the issuer's stock price, then the new ability of issuers and underwriters to canvass interest in the IPO from some of the largest and most sophisticated investors in the world should have improved the accuracy of these estimates. The failure to find such improvements, therefore, undercuts a key predictions of a broad range of information-based explanations for IPO underpricing in the academic literature.

7.2 Are Pricing Revisions and FMV Errors Influenced by the Issuer's Underwriters?

It is possible that the issuer's underwriters, in their valuation and diligence functions, influence the views of issuers about the initial pricing range decision. Indeed, the

behavioral theory of IPO pricing predicts that underwriters have incentives to *steer* issuers towards strategies that are designed to impose IPO underpricing. I present only descriptive data in this section. Nevertheless, the unconditional results suggest suggest that IMPREs and other bargaining aspects appear to have systematic underwriter-specific components that are worth exploring in future research.

Table 12 presents means for IPOs grouped by lead left underwriter for the bulge bracket investment banks and a "residual" category that lumps together the remaining underwriters that served as lead left underwriters in my data set.

[TABLE 12 HERE]

The results for the proportion of issuers that file under Rule 457(a) are of particular interest, since these fee calculation decisions are correlated with positive pricing revisions and serve as a proxy for IPOs with issuers that pursue a sub-optimal low-balling strategy in the analyses above. Moreover, the decision to file under Rule 457(a) is associated with substantially lower IPO proceeds in multivariate regression analysis, as shown in Table 10.

The most prestigious and "elite" investment banks–Goldman Sachs, Morgan Stanley, and J.P. Morgan–lead the way in the the proportion of IPOs that they manage in which issuers file under Rule 457(a) in 84%, 82%, and 78% of the time, respectively. In IPOs led by the most prestigious investment bank from the United Kingdom, Barclays, issuers file under Rule 457(a) 90% of the time. The issuers in the residual category, consisting of the 77 IPOs (10% of the total) in which a non-bulge bracket underwriter serves as lead left underwriter, file under Rule 457(a) only 43% of the time. These results suggest that more "prestigious" underwriters are more effective at convincing issuers of accepting the conventional advice of starting low on valuation to drive deal momentum, or that more issuers who are inclined towards the low-balling strategy select more "prestigious" underwriters.

Underwriter specific components appear to exist for other negotiated aspects of the bookbuilding process. For example, the IMPREs of only some underwriters appear to be biased. The mean FMV errors for Goldman Sachs, Morgan Stanley, J.P, Morgan, and BofA Merrill Lynch are 32.5%, 35.6%, 22.0%, and 10.3%, respectively,

suggesting that issuers systematically low ball IMPREs in the IPOs managed by these underwriters. The remaining underwriters have FMV errors within plus or minus two percentage points of 0, suggesting that the IMPREs in these IPOs are relatively unbiased.

Many of these differences are statistically significant. For example, a two-tailed t-test indicates that the differences in mean initial FMV Errors of IPOs managed by Goldman Sachs (32.5%) and by BofA Merrill Lynch (10.3%) are statistically significant below the 1% level.

The association between average initial FMV Errors and average first-day returns at the population level persists when means are aggregated at the lead left underwriter level. Underwriters that systematically low ball initial estimates and estimates at effectiveness tend to have higher average IPO underpricing relative to underwriters that systematically high ball their estimates. The correlation coefficient of *FMV Error* and first-day returns, each aggregated at the lead left underwriter level, is 0.65, while the correlation coefficient of *Book Error* and first-day return is 0.76.

7.3 Can Issuers Go Too High in Initial Estimates?

Perhaps so many issuers low ball their IMPRE because they are risk averse about the outcome of submitting an initial estimate that is *too high*? Perhaps there is some threshold amount of high balling above which investors actually *punish* issuers?

As shown in Table 14, my data suggests that issuers should not fear punishment if they grossly high ball estimates. There does not appear to be any level of high balling at which issuers receive less revenue relative to issuers that only mildly high ball their estimates. If anything, the data suggests that the the higher the initial estimate relative to ex post trading value, the more proceeds an issuer should expect in the IPO.

[TABLE 14 HERE]

It is true that no issuer can know whether they are submitting a low ball or high

ball estimate until after the IPO occurs and the market price is revealed. However, it is unlikely, except in the most extreme case, that this information problem will prevent an issuer and its financial advisors from stacking up their unbiased estimates about the issuer's valuation in order to submit an IMPRE that they can comfortably conclude will exceed the issuer's market value. Indeed, conditional on submitting a high ball estimate in my data set, issuers substantially overshoot their first day trading value, high-balling IMPREs by 22.7%.

8 Discussion

8.1 Non-Neutrality of High Ball and Low Ball Pricing Range Estimate Strategies

In a benchmark with full information and without negotiation costs, a high-balling or low-balling strategy should not matter. Rational, profit-maximizing sellers would set the price at the market clearing price and find sufficient buyers at that level.

However, the instrumental variable analysis above establishes that a strategy of low-balling the IMPRE yields less IPO proceeds than a high-balling strategy. Foregone proceeds increase with low balling. What explains the empirical results establishing non-neutrality of low-balling and high-balling strategies in U.S. firm commitment and bookbuilding IPOs? Prior theoretical results in auction theory suggest some possible candidates: affiliation of investors' bids, underwriter effort, and investor cooperation.

The differences in outcomes between the low-balling and high-balling strategies are unlikely to result from affiliation of investors bids, given the systematic magnitudes and persistence of the differences.

The non-neutrality results might be explained if underwriters vary their efforts at marketing the deal based on the IMPRE. If issuers willingly submit a low ball IMPRE low, underwriters will find plenty of demand at the given price and they will not need to work hard to bring up the price. Underwriters weigh the effort costs

saved against the foregone fee commissions for getting a higher price. If issuers instead insist on submitting a high ball IMPRE, underwriters will have to work very hard and incur costs to obtain enough demand to get the IPO done at a price that satisfies both the issuer and investors.

However, this explanation is unlikely given the amount of foregone fees that underwriters forego in IPOs with low ball estimates. Among the 278 IPOs with positive pricing revisions in the dataset (38% of all IPOs) with variables set to their average values, underwriters would leave an average of $9.6 million in fees on the table by failing to price an IPO at its aftermarket trading price.[6] It would be surprising if investment bank underwriters preferred economizing on effort costs instead of obtaining such a substantial payout.

Another possible explanation is that the IMPRE facilitates tacit cooperation among investors and underwriters by serving as a low ball reference point for bidding by investors. Investors face a trade-off between buying at the lowest price and the certainty of winning their desired allocations. If cooperation among a stable group of investors is possible, the group of investors can maximize their group payoffs by dampening bidding competition. Underwriters may also cooperate if investors reward them for allocations of underpriced stock in IPOs.

How might investors use IMPREs to cooperate? One possibility is that, when investors are solicited for demand information during the roadshows and they recognize a low ball IMPRE, they simply set their demand information at or around the estimated pricing range rather than at their true private valuation for the issuer's stock. Nothing nefarious is suggested. It is simply not incentive-compatible for investors to reveal unexpectedly positive demand information. Given long practice in IPOs, many investors understand that other investors will understand the logic of this strategy and each investor finds it is in his or her own best interests to not bid up IPO prices. This is the same logic that drives Benveniste and Spindt's investor compensation theory.[7]

[6] Mean initial returns of 36% times mean proceeds of $399 million times mean gross spreads of 6.658%.

[7] The result in Benveniste and Spindt (1989) depends on the assumption that underwriters act

When the initial estimate is a highball estimate, on the other hand, non-explicit cooperation among investors is more difficult. Under these circumstances, there is no low ball reference point around which investors can cluster their bids. Investors can always submit low ball indications of demand below their true valuation and desired allocation levels, but they have no way of knowing whether other investors will be doing the same and at what level they are doing so. In this context, investors risk losing desired allocations in the IPO by excessively low balling their bid. The intuition for this result is similar for why collusion is more difficult to sustain in a descending bid Dutch auction than an ascending bid English auction–the expected payoffs to cheating are greater in the descending bid context.

8.2 Why Do So Many Issuers Pursue a Low-balling Strategy?

The instrumental variable analysis establishes that a strategy of high-balling the IMPRE yields substantially more IPO proceeds than a strategy of low balling the estimate. The puzzle these results raise is the following: if issuers are rational economic agents that attempt to maximize their payoffs, why do more than half of all IPO issuers pursue a low-balling strategy that is associated with less IPO proceeds than a high-balling strategy? Why are IMPREs are systematically low balled by, on average, 13.6% relative to ex post trading value?

Given the link between low ball IMPREs and IPO underpricing, rational and sophisticated should "stack" their initial estimates and submit an estimate that exceeds the issuer's valuation by a comfortable margin, just as winner's "shave" their bids in anticipation of the winner's curse adverse selection problem in common-value auctions. However, and inconsistent with the plain instructions of Regulation S-K to submit a *maximum* estimate of the IPO price, almost a quarter of all IPOs submit a high end of the IMPRE that is *below* the ultimate IPO price, and these IPOs have mean first day returns of 43%. More than half of all IPO issuers submit

as perfect economic agents of issuers, an assumption I do not make.

a pricing range estimate below the issuer's stock price at the close of the first-day of trading after the IPO, with associated mean first-day returns of 33%.

The empirical results in this paper are consistent with the behavioral theory of IPO pricing I have set forth in other work (Corrigan, 2019). According to the behavioral theory, some, but not all, issuers are naive in the sense that they fail to backwards induce optimal strategies to maximize proceeds in an IPO process. Other issuers are sophisticated and attempt to sell their stock at the highest price possible. Underwriters and institutional investors have incentives to exploit the mistakes of naive issuers by steering them towards an underpriced IPO.

While it may be surprising that so many issuers fail to pursue a proceeds-maximizing strategy in a major financial transaction like an IPO, this paper is the first to establish the non-neutrality of low- and high-balling strategies. In the absence of the countervailing evidence generated in this paper and given that leading investment bankers and venture capital financiers advocate for a low balling strategy, it would not have been unreasonable for issuers to pursue such a strategy.

9 Conclusion

The design of auctions and other sales mechanisms are of first order important in corporate law practice and scholarship. Thus, the failure to empirically analyze the effects of different auction decisions in U.S. firm commitment and bookbuilding IPOs is surprising.

In this paper, I establish two main results. First, my instrumental variable analysis establishes non-neutrality of low ball and high ball IMPREs with respect to pricing outcomes. The effect of the issuer's low-balling or high-balling negotiation strategy on IPO pricing is independent of information production by investors. Second, I show that an exogenous shock that improved the information available to issuers and underwriters at the time that they make IMPRE decisions did not improve the accuracy of IMPREs or ultimate IPO pricing. These results suggest that the IMPREs are more sensitive to negotiation strategy than the information

environment.

The results I present in this paper are cross-sectional and backwards looking. I make no attempt to describe the general equilibrium effects if all companies contemplating a traditional IPO began to stack their price estimates and pursue the high ball strategies described in this paper.

10 Bibliography

Ausubel, L., (2002): "Implications of Auction Theory for New Issues Markets," *Brookings-Wharton Papers on Financial Services.*

Baron, D., (1982): "A Model of the Demand for Investment Banking Advising and Distribution Services for New Issues", Journal of Finance 37(4), 955-976.

Benveniste, L. & Paul A Spindt, (1989): "How Investment Bankers Determine the Offer Price and Allocation of New Issue," *Journal of Financial Economics* 24(343).

Biais et al., (2002): "An Optimal IPO Mechanism," *Review of Economic Studies* 69(1), 117-146.

Espinnase, P. IPOs: A Global Guide (2014).

Hurwicz, L. (1960): "Optimality and informational efficiency in resource allocation processes", in Arrow, Karlin and Suppes (eds.), *Mathematical Methods in the Social Sciences.* Stanford University Press.

Hurwicz, L. (1972): "On informationally decentralized systems", in Radner and McGuire, *Decision and Organization.* North-Holland, Amsterdam.

Kupor, S. & Alex Rampell, "In Defense of the IPO and How to Improve It, Part 2: Peeking Behind the Pop" (Oct. 30, 2020).

Latham & Watkins, (2016): "Tips for Upsizing and Downsizing an IPO."

Loughran, T. & Jay R. Ritter, (2002): "Why Don't Issuers Get Upset About Leaving Money on the Table in IPOs," *Review of Financial Studies* 25(413).

Myerson, R. B. (1981). Optimal auction design. *Mathematics of Operations Research*, 6:58–73.

Myerson, R. % Mark Mark Satterthwaite (1983): "*Efficient Mechanisms for Bilateral Trade*," Journal of Economic Theory 28, 265–281.

Sherman A. (2005): "Global Trends in IPO Methods: Bookbuilding versus Auction with Endogenous Entry," 78 *Journal of Financial Economics* 78(615).

Sherman, A.E., 2000: "IPOs and long term relationships: an advantage of book building," *Review of Financial Studies* 13(3), 697–714.

Sherman, A.E. & Sheridan Titman, (2002): "Building the IPO Order Book: Underpricing and Participation Limits with Costly Information," *Journal of Financial Economics* 65(1), 3-29.

Vickrey, W. (1961). Counterspeculation, auctions, and competitive sealed-tenders. *Journal of Finance*, 16:8–37.

Vickrey, W. (1962). Auctions and bidding games. *Recent Advances in Game Theory, Princeton University*, 15–27.

Wilson Sonsini Goodrich & Rosati, Guide to the Initial Public Offering (8th ed., 2016).

11 Appendix

FIGURE 1

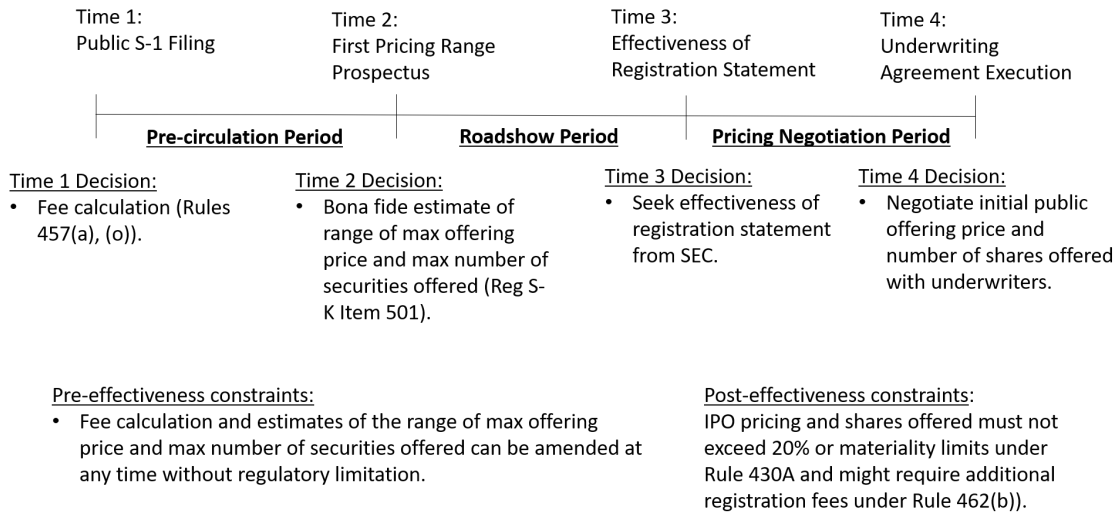


FIGURE 2

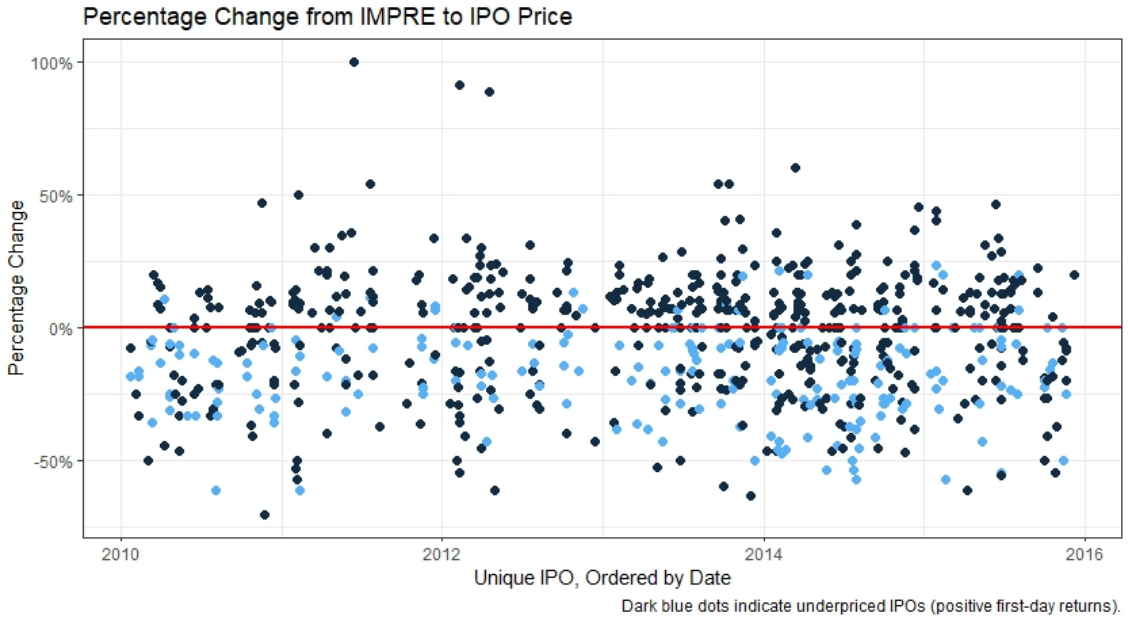
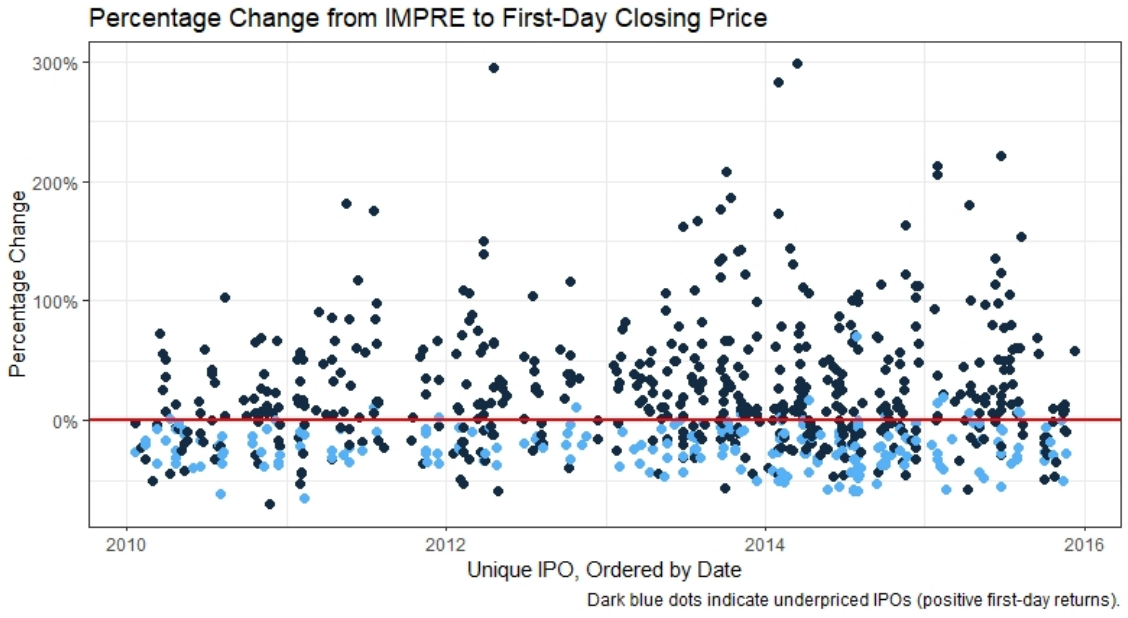

Percentage Change from IMPRE to IPO Price
100%
50%
0%
-50%
Percentage Change
2010
2012
2014
2016
Unique IPO, Ordered by Date
Dark blue dots indicate underpriced IPOs (positive first-day returns).

FIGURE 3


Percentage Change from IMPRE to First-Day Closing Price
300%
200%
100%
0%
Percentage Change
2010
2012
2014
2016
Unique IPO, Ordered by Date
Dark blue dots indicate underpriced IPOs (positive first-day returns).

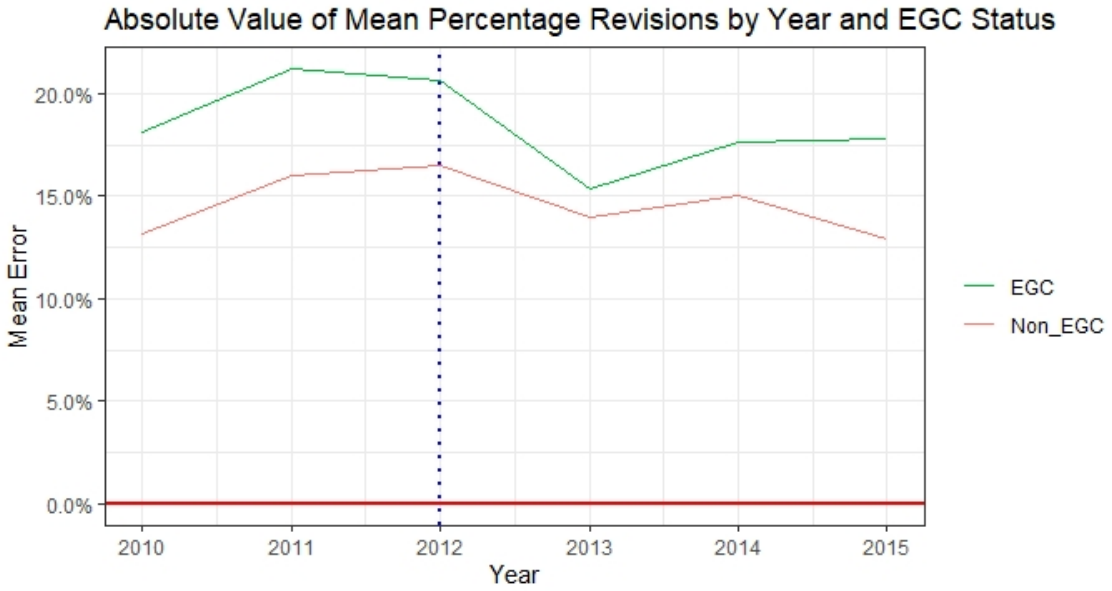


FIGURE 4

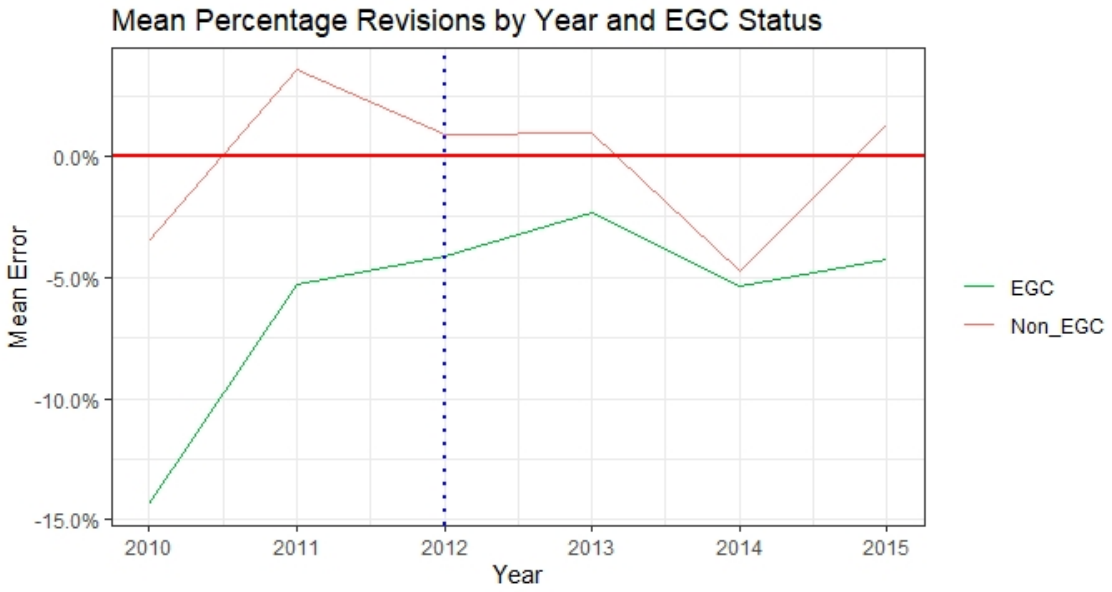


FIGURE 5

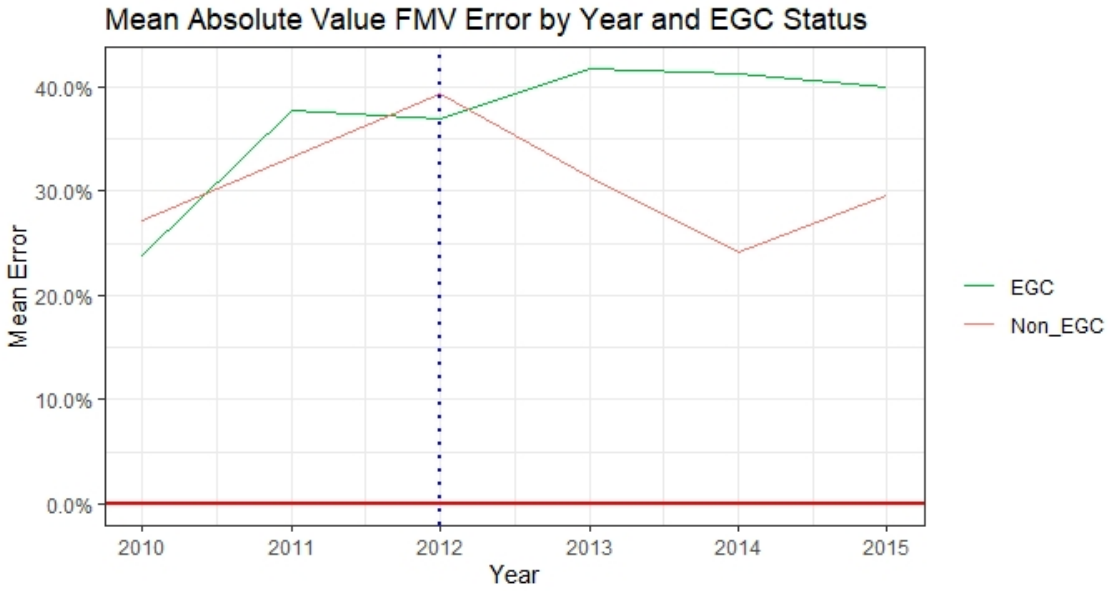


FIGURE 6

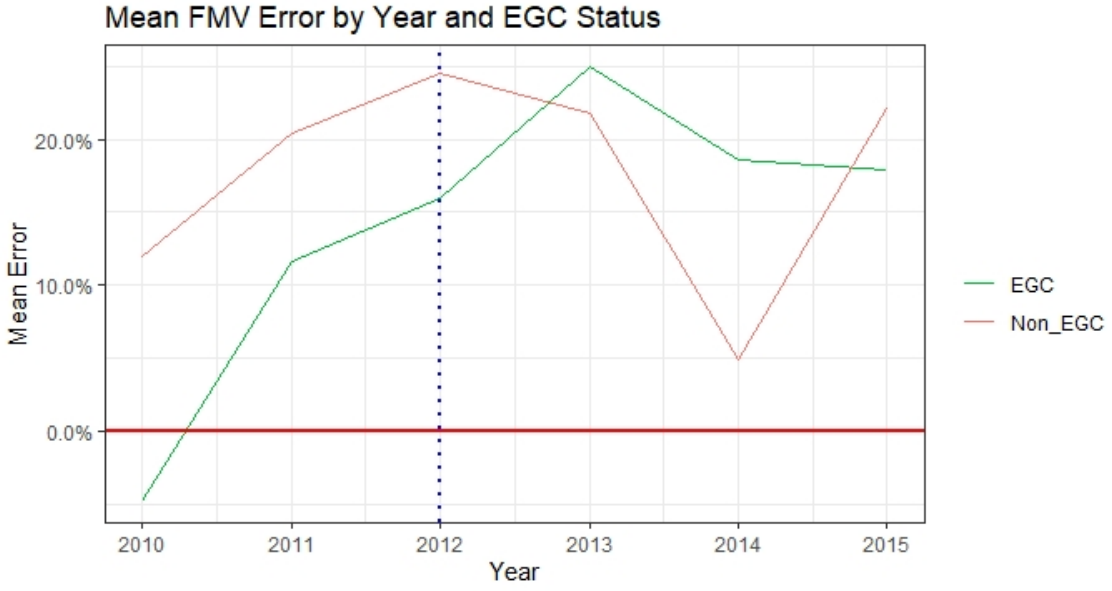


FIGURE 7

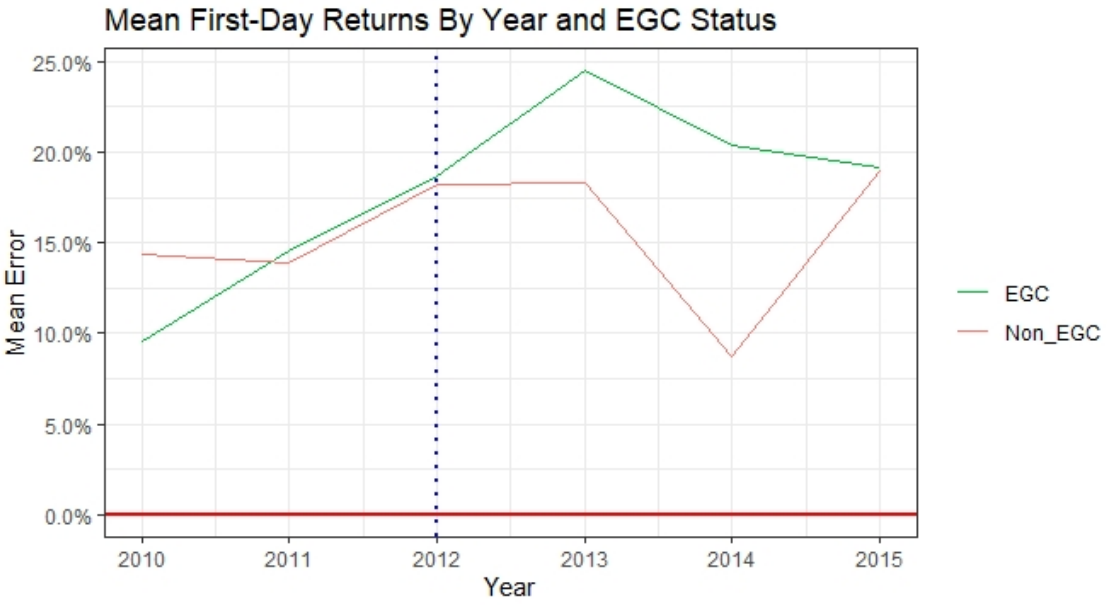


FIGURE 8

Table 1: Sample Descriptive Statistics

Statistic	N	Mean	St. Dev.	Min	Max
Initial Offer Price	735	14.8	6.1	5	52
Open Price	735	17.5	9.2	4.5	83.0
first-day Price	735	17.7	9.6	4.3	94.2
Tenth Day Price	735	17.8	9.6	3.5	78.6
Assets (millions)	735	1,336	6,419	0.1	137,238
Percent Revision	733	−0.1	0.2	−0.7	1.0
Venture Backed	735	0.5	0.5	0	1

Variable	First Public S-1 Filing	Pricing Range Prospectus	S-1 at Effectiveness	Actual IPO Number
Days to IPO	113	20	4.6	NA
Per. Filing 457(a)	1%	68%	72%	NA
Max. Proceeds (457(o) only)	174,582,440	296,434,334	310,719,783	113,805,341
High Price: Reg Fees	NA	17.99	17.03	14.8
No. Shares Registered	NA	17,314,225	17,706,709	19,469,840
High Price: Pricing Range	NA	16.59	16.21	14.8
Low Price: Pricing Range	NA	14.51	14.31	14.8
Primary Shares Offered	NA	25,187,567	16,211,003	10,562,748
Secondary Shares Offered	NA	2,948,619	3,206,001	3,493,514
Total Offered	NA	28,136,186	19,394,948	13,596,387
Deal Size	NA	450,910,960	326,497,254	252,600,000

Table 2: **Means of Key IPO Statistics at Four Points in Time**. The first three columns present means for the selected variable in the specified SEC filing. In the "Actual IPO Number column," I report the actual initial offering price, the number of each type of shares actually offered in the IPO, and the actual IPO deal size. A value of "NA" means that the specified filing does not always include a particular variable. *Days to IPO* reflects the number of days prior to the IPO that the filing is made. *Per Filing 457(a)* means the percentage of filers that calculate their registration fee using SEC Rule 457(a) (rather than Rule 457(o)). *Max Proceeds* applies only to those issuers that file under Rule 457(o), and indicates the total dollar amount of proceeds for purposes of the registration fee calculation. *High Price: Reg Fees* applies only to those issuers that file under Rule 457(a) and reflects the bona fide estimate of the maximum offering price for purposes of the registration fee calculation. *No. Shares Registered* applies only to those issuers that file under Rule 457(a) and reflects the total number of shares being registered for purposes of the registration fee calculation. *High Price: Pricing Range* and *Low Price: Price Pricing Range* are the high and low ends of the bona fide estimate of the maximum pricing range in the first pricing range prospectus. *Primary Shares Offered* and *Secondary Shares Offered* is the number of primary and secondary shares, respectively, offered according to the prospectus. *Total Offered* is the sum of the primary and secondary shares offered in the prospectus. *Deal Size* represents *Total Offered* multiplied by the midpoint of the pricing range in the pricing range prospectus.

Table 3: Bivariate Relationships Between Initial Estimates and Initial Offering Prices

	N	Proportion $\geq FMV$	Avg first-day Return
Positive Pricing Revisions	278	6.8%	36.1%
Negative Pricing Revisions	367	45.5%	3.6%
Zero Pricing Revisions	88	30.7%	10.6%

Table 4: Bivariate Relationships Between Initial Estimates and First-Day Returns

	N	Proportion $\geq FMV$	Avg. first-day Return
low ball Pricing Estimate	371	3.8%	32.5%
high ball Pricing Estimate	356	54.5%	0.5%

Table 5:

	Dependent variable:		
	First Day Return		
	(1)	(2)	(3)
Per. Revision	0.643^{***}	0.640^{***}	
	(0.057)	(0.060)	
Lowball			0.312^{***}
			(0.024)
Log Assets		-0.009	-0.007
		(0.006)	(0.005)
Float		-0.191^{**}	-0.165^{**}
		(0.077)	(0.079)
Net-Income		-0.0001^{**}	-0.0001
		(0.00003)	(0.00004)
Market Return		10.367^{*}	11.640^{**}
		(5.723)	(5.627)
VIX		0.001	0.002
		(0.002)	(0.002)
Participation		-0.007	0.019
		(0.049)	(0.049)
Venture Backed		0.073^{***}	0.065^{***}
		(0.023)	(0.022)
Fixed Effects?	No	Yes	Yes
Observations	733	699	699
R^2	0.254	0.486	0.499
Adjusted R^2	0.253	0.476	0.489

Note: Robust standard errors *p<0.1; **p<0.05; ***p<0.01

Table 6: Average Initial FMV Errors and Percentage Revisions Grouped by Filing Method

	457(a)	457(o)	Mean Difference
FMV Error	2.8%	-17.2%	19.8%
Per. Revision	-2.6%	-12.3%	9.7%

Table 7:

	Dependent variable:			
	FMV Error		Per. Revision	
	(1)	(2)	(3)	(4)
457a	0.190^{***}	0.123^{***}	0.091^{***}	0.057^{***}
	(0.033)	(0.035)	(0.017)	(0.018)
Log Assets		0.027^{***}		0.013^{***}
		(0.009)		(0.005)
Net-Income		0.00000		0.00002
		(0.0001)		(0.00004)
Market Return		9.320		1.279
		(9.835)		(5.723)
VIX		−0.001		−0.003
		(0.005)		(0.003)
Venture Backed		0.061^{*}		0.039^{**}
		(0.034)		(0.018)
Float		-0.587^{***}		-0.272^{***}
		(0.146)		(0.080)
Participation		0.108		0.060
		(0.081)		(0.052)
Year Fixed Effects?	Yes	Yes	Yes	Yes
Observations	735	700	733	699
R^2	0.074	0.153	0.116	0.182
Adjusted R^2	0.066	0.135	0.107	0.165
Note: Robust standard errors				*p<0.1; **p<0.05; ***p<0.01

Table 8:

	Dependent variable:		
	first-day Return		
	OLS	*instrumental variable*	
	(1)	(2)	(3)
Per Revision	0.640***	0.991***	1.326***
	(0.060)	(0.231)	(0.452)
Log Assets	−0.009		−0.020**
	(0.006)		(0.010)
Float	−0.191**		0.018
	(0.077)		(0.167)
Net-Income	−0.0001**		−0.0001*
	(0.00003)		(0.00005)
Market Return	10.367*		9.849
	(5.723)		(7.543)
VIX	0.001		0.003
	(0.002)		(0.003)
Participation	−0.007		−0.046
	(0.049)		(0.065)
Venture Backed	0.073***		0.043
	(0.023)		(0.032)
Year Fixed Effects?	Yes	Yes	Yes
First Stage F		31.06	11.62
Observations	699	733	699
R^2	0.486	0.396	0.299
Adjusted R^2	0.476	0.390	0.284
Note: Robust standard errors		*p<0.1; **p<0.05; ***p<0.01	

Table 9:

	Dependent variable:		
	first-day Return		
	OLS	*instrumental variable*	
	(1)	(2)	(3)
FMV Error	0.472***	0.478***	0.613***
	(0.036)	(0.091)	(0.159)
Log Assets	−0.014***		−0.019***
	(0.004)		(0.007)
Float	−0.074		0.018
	(0.066)		(0.126)
Net-Income	−0.0001**		−0.0001**
	(0.00003)		(0.00003)
Market Return	6.989		5.844
	(4.798)		(5.436)
VIX	−0.001		−0.0005
	(0.002)		(0.002)
Participation	−0.018		−0.032
	(0.040)		(0.042)
Venture Backed	0.067***		0.057**
	(0.019)		(0.023)
Year Fixed Effects?	Yes	Yes	Yes
First Stage F		32.29	12.2
Observations	700	735	700
R^2	0.617	0.586	0.591
Adjusted R^2	0.609	0.582	0.583
Note: Robust standard errors		*p<0.1; **p<0.05; ***p<0.01	

Table 10:

	Dependent variable:	
	First-day Return	
	(1)	(2)
Fees - 457(a)	0.091^{***}	0.090^{***}
	(0.022)	(0.023)
Log Assets		0.002
		(0.006)
Net-Income		-0.0001^{**}
		(0.00004)
Market Return		9.230
		(5.914)
VIX		-0.001
		(0.003)
Participation		0.060^{*}
		(0.033)
Venture Backed		0.111^{***}
		(0.025)
Year Fixed Effects?	Yes	Yes
Observations	735	733
R^2	0.283	0.312
Adjusted R^2	0.277	0.300
Note: Robust standard errors	*p<0.1; **p<0.05; ***p<0.01	

Table 11:

	Dependent variable:		
	FMV Error	Per. Rev.	Initial Return
	(1)	(2)	(3)
EGC	−0.077	−0.025	−0.034
	(0.071)	(0.037)	(0.040)
Post Jobs	−0.137	−0.022	−0.129**
	(0.130)	(0.062)	(0.065)
EGCxPost	0.081	0.041	0.048
	(0.080)	(0.039)	(0.043)
Log Assets	0.002	0.013*	−0.007
	(0.013)	(0.007)	(0.007)
Participation	0.105	0.076**	0.032
	(0.069)	(0.034)	(0.036)
Venture Backed	0.153***	0.033*	0.098***
	(0.047)	(0.020)	(0.027)
Income	−0.00001	0.00004	−0.00003
	(0.0001)	(0.00004)	(0.00004)
Fixed Effects?	Yes	Yes	Yes
Observations	644	642	644
R^2	0.208	0.177	0.358
Adjusted R^2	0.180	0.147	0.336

Note: Robust standard errors *p<0.1; **p<0.05; ***p<0.01

Table 12: Mean Values Grouped by Lead Left Underwriter

Underwriter	457(a)	AV FMV Error	FMV Error	Book Error	Price Change	Share Change	First-Day Return
Goldman, Sachs & Co.	83.6%	43.1%	32.5%	30.0%	1.4%	10.6%	25.7%
Morgan Stanley	81.7%	49.7%	35.6%	29.4%	1.5%	0.6%	24.8%
J.P. Morgan	78.1%	36.2	22.0%	20.8%	-0.2%	3.9%	19.2%
BofA Merrill Lynch	72.7%	31.3%	10.3%	12.0%	-5.7%	4.4%	16.8%
Credit Suisse	78.4%	32.6%	-0.2%	2.7%	-8.4%	8.1%	10.6%
Citigroup	64.4%	30.3%	-0.2%	5.4%	-5.3%	4.7%	10.0%
Deutsche Bank Securities	77.8%	20.1%	-1.5%	-1.5%	-9.5%	2.3%	7.9%
Barclays	89.7%	28.5%	-1.7%	9.9%	-4.5%	5.6%	14.3%
UBS Investment Bank	60.0%	21.2%	-2.1%	1.5%	-4.8%	6.1%	5.8%
Residual	39.0%	28.9%	-0.1%	4.7%	-5.7%	14.1%	10.3%

Table 13: **Means of IPO Statistics Grouped by Lead Left Underwriters**. *457(a)* indicates the percentage of IPOs in which issuers calculated their registration fee when they filed the initial pricing range prospectus using SEC Rule 457(a) (rather than Rule 457(o)). *FMV Error* is calculated as the difference between the price of the issuer's stock at the end of the first-day of trading less the midpoint of the pricing range in the preliminary pricing prospectus, all divided by the midpoint of the pricing range in the preliminary pricing prospectus. *AV FMV Error* is the absolute value of *FMV Error*. *Book Error* is calculated as the difference between the price of the issuer's stock at the end of the first-day of trading less the midpoint of the pricing range in the prospectus filed at effectiveness, divided by the midpoint of the pricing range in the prospectus filed at effectiveness. *Price Change* is calculated as the initial offering price in the IPO less the midpoint of the pricing range estimate in the prospectus at effectiveness all over the midpoint of the pricing range estimate in the prospectus at effectiveness (i.e. percentage revisions from the prospectus at effectivness to the final IPO offering price). *Share Change* is calculated as the number of shares offered in the IPO less the number of shares estimated to be offered in the prospectus at effectiveness, all over the number of shares estimated to be offered in the prospectus at effectiveness.

Table 14: Initial Returns Grouped by high-balling Range

FMV Error	No. IPOs	Mean first-day Return
$\leq$ 0 and $<$ -0.1	82	3.9%
$\leq$ -0.1 and $<$ -0.2	89	2.5%
$\leq$ -0.2 and $<$ -0.3	85	-1.7%
$\leq$ -0.3 and $<$ -0.4	51	-2.6%
$\leq$ -0.4 and $<$ -0.5	32	0.3%
$\leq$ -0.5 and $<$ -0.6	14	-6.8%
$\leq$ -0.6 and $<$ -0.7	2	-4.5
$\leq$ -0.7	1	1.8%