The IPO Share Adjustment Puzzle

Craig Dunbar†

This version: February 21, 2023

Abstract

Approximately 60% of IPO issuers adjust primary share over the registration period and 15% adjust secondary shares. I find that first day returns are significantly positive related to primary share adjustments and insignificantly related to secondary share adjustments. These relations are puzzling as information production / revelation and agency theories that are used to explain price adjustments would predict significant negative relations. I introduce an explanation for the effect of share adjustments on first day returns that considers bargaining between issuers and new investors over gains arising because IPO proceeds can be invested in value adding projects

JEL classification: G10, G24, G32, C12, C21, C25, C58

Keywords: Initial public offerings, underwriters, price adjustment, share adjustment, first-day returns

† Corresponding Author. Ivey Business School, Western University, 1255 Western Road, London ON, N6G0N1, Canada.

1. Introduction

Firms attempting to go public in the U.S. through an initial public offering (IPO) must follow a highly regulated process. To begin, they file a registration document with the Securities and Exchange Commission (SEC). While the initial document does not have to include any pricing information, the issuer must file an amendment at some point before approaching investors to solicit indications of interest indicating the number of share it intends to sell and a bona fide range of prices at which it expects to price. The final offering terms can differ significantly from those in that first pricing amendments and a large literature has theoretically and empirically examined price adjustments and their implications for first day returns. Far less attention has been paid to share adjustments. I document that approximately 60% of issuers adjust primary shares between the first pricing amendment and the final offering and a further 15% adjust secondary shares. The adjustments can be large. For IPOs that increase (decrease) primary shares, the average adjustment is 16.4% (-9.8%). For IPOs that increase (decrease) secondary shares, the average adjustment is 13.8% (-16.6%). In this paper I examine share adjustments and their impact on IPO pricing.

I begin by developing predictions regarding the impact of share adjustment on first-day returns (IPO underpricing) relying on theories that have been argued to be the most important in explaining price adjustment effects. I posit that information production / revelation theories (e.g., Benveniste and Spindt, 1989, Sherman and Titman, 2002) would predict that share adjustments have a negative impact on first day returns. Last minute adjustments to shares offered should not impact incentives to reveal information or invest in information acquisition. But if shares are increased, rationing declines, allowing the issuer to meet any pre-commitments to cover information related costs with less per share underpricing. I also posit that agency theory (e.g., Loughran and Ritter, 2002) would predict that share adjustments have a negative impact on first day returns. By increasing shares offered at the last minute, total money left of the table that is transferred to investment banking clients can be increased even if first day returns are lower. Positive share adjustments may be a particularly useful tool for underwriters to increase wealth transfer when competition for deal mandates necessitated a higher filing price. The higher filing price leaves less room to positively adjust prices while still underpricing. Overall, agency arguments predict lower first day returns when issuers increase shares offered, all else equal.

I empirically examine the relation between first day returns and primary and secondary share adjustments for U.S.. IPOs between 2002 and 2020. Using ordinary least squares regression I find no significant relation between secondary share adjustments and first day returns but a significantly *positive* relation between primary share adjustments and first day returns. A one standard deviation change in primary price adjustments leads to a 2% increase in first day returns, a meaningful relation since the average first day returns are approximately 15% in my sample. In an attempt to establish a causal relation, I use propensity score matching. I find a sample of firms that do not increase primary shares and match along a number of important dimensions (including price adjustments) to issuers that do increase primary shares. Comparing these matched samples, I find that issuers increasing primary shares experience 5.7% higher first day returns. Since neither information production /revelation or agency arguments predict such a relation, I refer to this as the share adjustment puzzle.

To explain the puzzle, I introduce an explanation for IPO pricing that considers bargaining between issuers and new investors over gains arising because IPO proceeds can be invested in value adding projects. Consistent with the empirical evidence, I show that as long as pricing is such that both issuers and investors realize net gains, changes to primary shares offered should lead to higher first day returns. The intuition behind this finding rests on the idea that when IPO proceeds can be deployed in value adding projects, increasing the number of share has a positive impact on the value of the firm's shares post-offering. If primary shares are increased holding the offering price constant, first-day return should increase. Since the bargaining arguments also predict that secondary share adjustments should have no impact on first day returns, the theory fully explains the puzzling empirical patterns. Importantly, the bargaining arguments can also can be used to explain other important empirical IPO underpricing patterns including the positive effect of ex ante uncertainty proxies on first day returns and the partial price adjustment phenomenon.

Overall, I believe this study makes a number of contributions to the IPO literature. While price adjustments have been extensively studied theoretically and empirically, far less attention has been paid to share adjustments. I extend the literature empirically showing the extent of share adjustments that occur and show the impact of share adjustments on first day returns. I also add to the theoretical literature by introducing a bargaining explanation for IPO pricing. The theory can explain the share adjustment – IPO underprizing relation. It can also explain other important empirical regularities related to IPO pricing. The theory is novel in that it does not rely on information frictions or agency arguments to explain IPO pricing.

2. Shares Offered and IPO Pricing: Existing Evidence and Related Theories

The IPO literature has long recognized that final offering terms can differ significantly from what was initially proposed in registration documents filed with the SEC when a firm begins the public share issuance process. In the U.S., an issuer files a preliminary prospectus (e.g., S-1, SB-1, F-1) with the Securities and Exchange Commission (SEC) to begin the IPO process. In most cases, that preliminary prospectus leaves pricing related information blank, including the number of shares to be sold and the price per share. To comply with SEC's Regulation S-K, Item 501(b)(3), the issuer must file an amended prospectus (e.g., S-1/A, SB-1/A, F-1/A) indicating the expected number of shares to be sold and a bona-fide estimate of price range per share before its approaching potential investors. Starting with Hanley (1993), several studies have documented a strong "partial adjustment" effect with respect to offering prices (e.g., Bradley and Jordan, 2002, Loughran and Ritter, 2002, Lowry and Schwert, 2004, Edelen and Kadlec, 2005). First-day returns, the return from IPO offer price to either open or close of first day public trading price (so-called IPO underpricing), is strongly positively related to price adjustments (typically measured as the percentage change from midpoint of the initial filing range to IPO offer price). Several theories emerged to explain this relation relying on information acquisition (e.g., Benveniste and Spindt, 1989, Sherman and Titman, 2002) and agency (e.g., Loughran and Ritter, 2002, Ljungqvist and Wilhelm, 2005) arguments.

While the theoretical and empirical literature on IPO price adjustments is quite voluminous, few studies have examined share adjustments. Ang and Brau (2003) document significant share adjustments for US IPOs between 1980 and 1997. Their focus is on secondary share adjustments and concealment strategies, where secondary and primary share adjustments differ. Brau, Li and Shi (2007) also document significant share adjustments but their focus in on the effect of secondary shares on aftermarket share performance. Zheng (2012) empirically documents significant share adjustments in IPOs. His focus in on the role of information precision on the adjustment process. He examines factors affecting share adjustments but does not then examine if and how those share adjustments affect pricing. While the potential impact of primary share adjustments on IPO pricing has not been directly studied, in the remainder of this section I consider existing theories and explore how they can be used to explain share adjustments and make predictions regarding the impact of these adjustments on IPO pricing.

2.1. Information Production/Revelation Theories and Primary Share Adjustments

Benveniste and Spindt (1989) develop a model where the underwriter pre-commits to a pricing and share allocation scheme to resolve information asymmetries between the issuer and informed investors. They note that informed investors have an incentive to downplay positive information they possess about the value of an issuer as this could result in a lower offering price. The underwriter addresses this incentive by pre-committing to a pricing and allocation that scheme that encourages truthful revelation of information. Investors revealing positive information are given priority in share allocation. When more positive information arises, the underwriter pre-commits to pricing such that first day returns are high. While not addressed in their paper, adjustments to shares offered can impact the equilibrium. In their model, underpricing arises when shares that can be sold to investors revealing positive information must be rationed. If the issuer increases the number of shares to be offered at the last moment, rationing can decline, and investors can achieve increases in value promised even with more complete price adjustments. Since first day returns decline with more complete price adjustments, I expect to find a negative relation between first day returns and share adjustments, all else equal.

Sherman and Titman (2002) extend the Benveniste and Spindt (1989) model by considering costs investors must bear to acquire valuation relevant information. They also consider the optimal choice of number of potential investors to approach regarding an IPO. While they do not consider changes in the number of shares offered, underpricing emerges in part to at least compensate investors for information production. By increasing the number of shares in an IPO at the last moment (after the selected investor set have been approached and their investment in information has been made), the issuer can reduce first day returns while ensuring investors still receive sufficient total compensation for information production.[1]

[1] While I focus on information production/revelation theories, I believe similar predictions should emerge from IPO models that consider underpricing as an efficient response to different information frictions. Rock (1986), for example, considers information asymmetries between informed and uninformed investors. In his model, underpricing emerges to compensate uninformed investors for the winner's curse they face. If issuers adjust shares offered in ways that reduces rationing, the winner's curse problem can be reduced, resulting in lower required average first day returns.

Overall, I believe information production and revelation theories would predict a negative relation between first day returns and share adjustments. While my focus is on primary share adjustments, the theory is silent on form of shares offered to investors. So, changes in primary or secondary shares should have similar effects.

2.2 Agency Theory and Primary Share Adjustments

Loughran and Ritter (2002) rely on agency-based arguments to explain the partial adjustment of IPO prices. They argue that issuers will consider gains and losses relative to some anchor price. Formally issuers consider net wealth gains defined as follows:

$$(S_B - S_S) \times (P_A - A) + S_S \times (OP - A) - (S_S + S_P) \times (P_A - OP) \quad (1)$$

where S_B is the number of share pre-IPO, S_S is the number of secondary shares sold, S_P is the number of primary shares sold, OP is the IPO offer price, P_A is the price post IPO and A is some anchor price. Loughran and Ritter argue the midpoint of the initial price range is a reasonable anchor price. The number of primary shares only impacts this expression though the final term, $-S_P \times (P_A - OP)$. That part of the expression represents the total "money left on the table" from primary share underpricing. An underwriter can benefit from increasing total money left on the table in two ways. First, an underpriced IPO can require less marketing effort (Baron 1982). Second, the underwriter can benefit if some positive proportion of this money left on the table is "returned" through soft dollar commissions (Ellis, Michaely and O'Hara, 2000). Loughran and Ritter (2002) argue that when good news arises after the anchor price is set (whether that news is specific to the firm or market wide), an underwriter can respond by only partially adjusting prices since issuers perceive that losses due to money left on the table are offset by gains on insider holdings due to appreciation in value relative to the anchor price.

Ljungqvist and Wilhelm (2005) explore implications of Loughran and Ritter's (2002) use of agency and prospect theories to explain the partial price adjustment effect in IPOs. They test whether net gains as represented by expression (1), are positively associated with one indicator of the issuer's satisfaction with the IPO outcome – its willingness to retain the lead underwriter in that role for follow on equity offerings. Consistent with the theory, they find a significantly positive relation between their net gain measure based on expression (1) and the probability of lead underwriter retention.

While not considered by prior research, the agency framework can also be used to predict implications of share adjustments. First, I need to recognize the dilutive effects of underpricing on post IPO pricing. As noted by Barry (1989), the price of an IPO firms share post IPO (P_A as defined above) will be given by the following expression:

$$P_A = \frac{P_B \times S_B + S_P \times OP}{S_B + S_P} \tag{2}$$

where P_B represents the value of each share prior to the offering. Increases to OP have a positive effect on aftermarket prices, P_A. As OP declines and first-day returns (underpricing) increase, the aftermarket price, P_A, declines.

Recognizing the dilutive effect of underpricing, I return to expression (1). As noted above, primary shares impacts expression (1) only through the final term. As primary shares increases, additional wealth is transferred from the issuer to new investors if shares are underpriced. While desirable for the underwriter, changing only primary shares offered increases the likelihood expression (1) becomes negative which is not desirable for an underwriter hoping to realize future mandates. I expect, therefore, that primary share increases to be accompanied by some offering price increase. Wealth transferred to new investors can be increased overall, the third part of expression (1), but increasing the offering price would have a positive impact on the first two parts of expression (1) (directly in the second term but indirectly for the first term due to the positive effect of offer price increases on P_A).

Overall, I believe agency arguments would lead to a prediction that share adjustments have a negative impact on observed first day returns. Inspection of expression (1) indicates that the impact of primary and secondary share adjustments could be different. Collecting terms, the impact of secondary shares on expression (1) would be $-2 \times S_S \times (P_A - OP)$. Changes to secondary shares has twice the impact on wealth transfer from existing to new investors as changes to primary shares. I expect, therefore, that the relation between secondary share changes and first day returns will be more negative than the relation between primary share changes and first day returns under agency theory. An issuer increasing secondary shares might have to increase offering prices more to ensure increases to the first term in expression (1) offsets some of this larger wealth transfer.

2.3. Primary Share Adjustments and the Dilutive Effect of Underpricing

As noted above, a reduction to the IPO offering price has a dilutive effect on the aftermarket share price for an offering firm. Using expression (1), first day returns (or underpricing; labeled *UPR* below) can be expressed as follows:

$$UPR = \frac{P_A - OP}{OP} = \frac{S_B \times (P_B - OP)}{OP \times (S_B + S_P)} \tag{3}$$

Inspection of expression (3) reveals that first day returns decline as primary shares included in the IPO increase, all else equal. Interestingly, secondary shares do not enter expression (3) so there is no purely mechanical impact of secondary share adjustments on IPO first-day returns.

3. Data and Empirical Evidence

I obtain data on all U.S. firm-commitment IPOs from January 1, 2002, to December 31, 2020, from the Thomson Financial Securities Data Company New Issues (TFSDC) database. I start the sample the dot-com bubble period where first-day returns were found to be "unusually large" (Ljungqvist and Wilhelm, 2003). Consistent with much of the literature, I exclude closed-end funds, real estate investment trusts, limited partnerships, unit investment trusts, unit offerings with warrants, IPOs by banks, depositary receipts and shares, IPOs with offer prices below $5 or proceeds less than $10 million, and IPOs not listing on the American Stock Exchange, Nasdaq, or NYSE. I exclude offerings if stock returns are not available on the Center for Research in Security Prices (CRSP) database. I also drop IPOs where either the initial filing or final offering terms indicate the IPO is a pure secondary (i.e., no proceeds are raised for the issuer), those with no pre-IPO shares outstanding, and those that do not have a positive initial price range (i.e., when first disclosed the high filing price must exceed the low filing price). The final sample covers 2,046 IPOs from 2002 to 2020.

In Panel A of Table 1 I report counts of IPOs based on share and price adjustments for the sample of 2046 IPOs. In each column I sort IPOs into 3 groups based on whether the final offer price is below the low price indicated in the first pricing amendment ("price below range"), above the high price indicated in the first pricing amendment ("price above range"), and all others ("price in range"). Overall, there are 659 IPOs that price below the range, 498 that price above, and 889 that price in the range. In the first 3 rows I further subdivide based on primary share adjustment adjustments. There are 288 offerings where primary shares offered is less than that indicated in the first pricing amendment. There are 824 offerings where the primary shares offered is more than that indicated in the first pricing amendment. And there are 934 where there is no change in the number of primary shares offered. While prices are more likely to be revised down, primary shares are more likely to be revised up. There does appear to be some positive correlation between price and share adjustments, however. Primary share are more often revised down (up) when prices are revised down (up). The next 3 rows of Table 1, Panel A, provides a similar breakdown for secondary shares. In most cases (1743) secondary shares offered are the same as that indicated in the initial pricing amendment. In 154 cases secondary shares are revised down and in 149 cases they are revised down. The final 3 rows of Table 1, Panel A, breaks things down based on consistency of primary and secondary share adjustments. There are 102 cases where primary shares are increased and secondary shares decrease. There are also 53 cases where primary shares are decreased and secondary shares increase. The remaining 1891 are labeled to be situations where share movements are not inconsistent. Ang and Brau (2003) found approximately 20% of IPOs in their sample from 1980 to 1997 had inconsistent primary and secondary share changes, much higher than the 8% in my sample, perhaps indicating that concealment has become less significant over time.

[Insert Table 1 Here]

In Panel B of Table 1, I report mean ***first-day returns***, the return from IPO price to closing day 1 trading price, for samples broken down by primary and secondary share groupings (see Appendix A for detailed definitions of all variables used in this study). Consistent with the literature on partial adjustments to offer price changes, average first-day returns are generally larger as you move from the left to right columns. For secondary share change groupings, there is no obvious pattern. When the offer price is below the initial price range, first day returns are lowest when secondary shares increase. But first day returns are lowest when secondary shares decline in cases where the offer price is within the initial price range. In contrast, the patterns for primary share adjustments are strong and consistent. Across all groupings based on price adjustments, first day returns are lowest when primary shares decline and highest when primary shares increase.

While the univariate statistics are consistent with primary (secondary) share adjustments having a positive (insignificant) effect on first day returns, I recognize that there could be important differences across IPOs from the groupings in Table 1 that are driving the patterns. To examine this possibility, I estimate ordinary least square (OLS) models where the dependent variable is first-day returns. To control for the partial price adjustment effect I include two variables: ***Price Adjustment if Negative*** and ***Price Adjustment if Positive***. ***Total Price Adjustment*** is measured as the final offering price divided by the average of the high and low initial filing prices, subtract 1. ***Price Adjustment if Negative*** equals ***Total Price Adjustment*** when it is negative and equals zero otherwise. ***Price Adjustment if Positive*** equals ***Total Price Adjustment*** when it is positive and equals zero otherwise. I include these variable separately as much of the literature finds different impacts of positive and negative price adjustments (see Lowry and Schwert, 2004, Edelen and Kadlec, 2005, Dunbar and King, 2023). To examine the impact of share adjustments on first-day returns I include ***Secondary Share Adjustment*** which equals the change in secondary shares from filing to offering divided by the total shares (primary and secondary) from the first filing. I also include ***Primary Share Adjustment***, which equals the change in secondary shares from filing to offering divided by the total shares (primary and secondary) from the first filing.[2]

In addition to these price and share adjustment variables of interest, my models include a number of control variables motivated by the literature on IPO underpricing. ***Market Condition*** variables include measures of market and industry returns either prior to first pricing of between first pricing and the offering. I also include a measure reflecting the amount of capital raised through IPO over the 12 months prior to first pricing***.*** ***Issue/Issuer Characteristic*** variable include

[2] Changes are scaled by total shares filed as there are cases where either the primary or secondary shares initially filed equals zero. Results are similar when scaling primary share changes by primary shares filed and secondary share changes by secondary shared filed, restricting the samples to include data where such variables are measurable.

a number of measure to proxy for firm risk and/or capital need. I include measures of firm scale including last 12-month (LTM) revenues, assets and debt. I also include a measure of offering size. All measures are defined as of the first pricing date so offering size is based on the number of share proposed (primary and secondary) multiplied by the average of the low and high filing price. I include a measure of firms size and dummy variables to reflect whether the firm has private equity or venture capital backing. In most cases, measures are transformed logarithmically as is typically done in the literature. The final issue measure included is overhang which measures the number of shares retained dividend by the number of share to be offered (again, measured as of the first pricing date (see Bradley and Jordan, 2002). The final measures included proxy for ***Underwriter Reputation***, including market share for the lead-left underwriter (the bookrunner whose name appears at the top left on the cover page of the IPO prospectus; see Dunbar and King, 2023), and the lead-left underwriter's Carter-Manaster Ranking (Carter and Manaster, 1990).

In Table 2 I report descriptive statistics (means, medians and standard deviations) for all independent variables introduced above. While I highlight the economic significance of certain key variables in the discussion of various models, below, I do not discuss all variables. Table 2 allows the reader to gain greater insight into to the economic impacts of all variables across models.

[Insert Table 2 here]

In the first column of Table 3, I present estimated regression results for the full sample of IPOs. In addition to share and price adjustment variables, market, issuer, and underwriter controls, I include time and industry fixed effects. Specifically, I include dummy variables for each quarter in my sample period (e.g., a dummy variable for the first 3 months of 2002 equals one if the IPO occurs in that period and zero otherwise). I also include dummy variables capturing which industry an issuer is part of relying on Fama and French's 10 industry classification scheme (see https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.htm). Consistent with the existing literature, first-day returns are significantly negatively related to ***Log of Long-Term Debt*** and significantly positively related to Fama-French 48 Industry Return 30 Days Pre First Pricing, ***Venture Capital Backed Dummy***, and ***Overhang based on filing terms***. Consistent with the literature on partial adjustments, ***Price Adjustment if Negative*** and ***Price Adjustment if Positive*** are significantly positively related to first day returns with the latter effect being significantly larger. Economically, the most significant variable in model (1) of Table 3 is ***Price Adjustment if Positive.*** A one standard deviation increase in this variable drives a 12.4% increase in first day returns. This effect is huge considering the mean (median) first day return in the sample is 15.3% (7.4%) and the standard deviation of first day returns is 24.3%. The second most significant variable, economically, is ***Venture Capital Backed Dummy.*** VC backed IPOs experience first-day returns that are 3.6% higher than non-VC backed IPOs, all else equal.

[Insert Table 3 here]

While ***Secondary Share Adjustment*** is not significantly related to first-day returns, ***Primary Share Adjustment*** has a significantly positive coefficient. The effect of ***primary share adjustment*** on IPO is quite large. A one standard deviation increase in ***primary share adjustment*** drives a 2% increase in first-day returns, all else equal. The multivariate analysis is consistent with the univariate patterns uncovered in Table 1. Secondary share changes are unrelated to first day returns, and primary share adjustments are significantly positively related.

While model (1) of Table 3 uncovers a significant relation between primary share adjustments and first day returns, causation is more challenging to establish. As shown earlier, positive share adjustments occur more frequently when price adjustments are positive and less frequently when price adjustments are negative. It is possible that primary share increases cause first day returns to *decline* relative to what they would be otherwise and a regression model like that in model (1) of Table 3 finds a positive association if positive size adjustments occur disproportionately in settings when first day returns happen to be high.

The remaining ordinary least squares models in Table 3 consider different subsamples of IPO in an attempt to minimize the possible effect noted above. In model (2) I exclude IPOs that price above the range. These IPOs tend to have the highest first day returns so positive share adjustments in that subsample are more likely to mechanically show a positive association. In model (3) I further reduce the sample to only include IPOs that price within the initial filing range. For those IPOs, price changes are less material so direct effects of primary shares should be less linked to pricing effects. In both models (2) and (3) the impact of primary and secondary share adjustments on first day returns does not materially change from what was reported in model (1) for the full sample.

As an arguably stronger test of causality for the primary share adjustment and first day return relation, I next consider a matching strategy. I identify two groups of IPOs – those with positive primary share adjustments and all others. In Table 4, model (1), I estimate a probit model to predict positive adjustments. Independent variables include all controls variables from Table 3 including time and industry fixed effects. I report marginal effects, which represent effects on the probability of primary share increases (in percent) from a one standard deviation change in each independent variables (a one-unit change for dichotomous variables). ***Nasdaq Composite Return 30 days pre first pricing***, ***Log of LTM Revenues***, ***Lead-Left LTM Market Share***, and ***Price Adjustment if Negative*** all have significantly negative effects on the likelihood of positive share adjustments. ***Log of Long-Term Debt*** and ***Price Adjustment if Positive*** have significantly positive effects on the likelihood of positive share adjustments. Economically, the most significant variable in this model is ***Price Adjustment if Positive***. I find a one standard deviation increase in ***Price Adjustment if Positive*** drives a 9.4% increase in the probability of positive share adjustment.

[Insert Table 4 here]

I use model (1) of Table 4 to generate propensity score matches for each IPO having positive share adjustments Formally, I identify viable treated and matched offerings using one-to-one nearest neighbor matching with replacement (Caliendo and Kopeinig, 2008). I restrict matches to IPOs having propensity scores with a "caliper" (or difference in propensity scores) of no more than 1%. I also limit the set of matched IPOs to those with the same "common support" to eliminate matching of IPOs with propensity scores above the maximum or below the minimum score for the sample of treated firms. Before matching there are 824 issuers increasing primary shares with 1222 either reducing primary shares of leaving things unchanged. The matching process reduces the set of "treated" issuers (those increasing primary shares) to 804.

In Table 5 I compare attributes of IPOs before and after matching. Before matching there are several significant differences between IPOs that increase primary shares and those that do not. IPOs increase primary shares after periods when more capital has been raised through IPO. Almost all issue and issuer characteristics variable are significantly different for IPOs increasing primary shares. Firms increasing primary shares file for smaller offerings, are smaller (based on assets, revenue and debt), and younger, are less likely to be private equity backed but more likely to be venture capital backed. IPOs increasing primary shares are taken public by less reputable lead-left underwriters. Issuers are also more likely to increase primary shares if price adjustments are more positive. After matching, all of these differences become statistically insignificant, indicating that the matching process has effectively identified similar firms.

[Insert Table 5 here]

In the second model of Table 4, I present a model of IPO first-day returns for the propensity score matched sample of offerings. I include all control variables as in Table 3. All standard errors are clustered at the IPO level since my matching process allows for a firm not increasing primary shares to be used multiple times as a match. The impact of control variables is similar to what is found in Table 3, model (1) for the full sample of IPOs I also include a dummy variable which equals one if the IPO increases primary shares (i.e., is "treated"). This variable is significantly positively related to first day returns. Issuers increasing primary shares have first day returns that are 5.7% higher than those not increasing primary shares.

4. Positive Value Projects, Bargaining, Primary Share Adjustments, and IPO Underpricing

Overall, the evidence in Section 3 indicates a strong positive relation between primary share adjustments and first day returns. That evidence is puzzling in that all theories discussed in Section 2 predicted a ***negative*** relation. In this section, I develop an explanation for the positive impact of primary share adjustments on IPO first-day returns. Importantly I consider bargaining over the value added by capital raised in an IPO. First, I introduce several important variables:

EV_t = enterprise value (equity plus debt) of the firm at point t relative to the IPO (t=B if before the capital raise and t=A if after the capital raise)

D_t = debt outstanding at point t relative to the IPO

C_B = Capital available to be invested before the IPO

E_t= the total value of equity at point t relative to the IPO (note: $E_t = EV_t – D_t$)

M = NPV % multiplier for capital raised in the IPO, net of direct issuance costs (M=1 if the market value equals net capital raised)

i = the percentage of the IPO proceeds used to invest in new projects (the remaining proceeds will be used to retire debt)

Given these variables and those introduced earlier, I note that $P_B = E_B/S_B$. In the analysis, below, I consider one special case:

$$EV_B = C_B \times M \tag{4}$$

In defining enterprise value this way, I am assuming that the value of projects invested in prior to the IPO is similar to the projects investable with incremental funds. While not necessarily realistic (since firms likely invest first in projects that add the most capital, the multiplier in equation (4) would likely be less than *M*), this assumption allows me to consider implications from changes in *M*. Equation (4) implies that news resulting in a y% change in the valuation of new projects to be invested in with IPO proceeds will also result in a y% change in valuation of exiting projects. Implications drawn should be similar to situations where changes to valuation of new projects is highly correlated with changes to valuation of existing projects, which is arguably more plausible.

Given these definitions it is possible to identify the enterprise value that would emerge after the IPO, labeled EV_A. formally:

$$EV_A = EV_B + i \times S_P \times OP \times M = C_B \times M + i \times S_P \times OP \times M \tag{5}$$

Enterprise value should increase based on the value of new capital raised in the IPO that is invested in new projects. One can also measure the total value of equity post IPO. Noting the debt after the IPO is simply the debt before the IPO less any debt retired, equity after the offer, E_A, can be defined as follows:

$$E_A = EV_A - D_A = C_B \times M + i \times S_P \times OP \times M - (D_B - S_P \times OP \times (1 - i))$$

$$E_A = (C_B \times M + i \times S_P \times OP \times [M - 1] - D_B) + S_P \times OP \tag{6}$$

The first part of the expression represents the value to pre-IPO shareholders conditional on the capital raised. If the firm were public, its value would likely increase to the amount in parentheses as soon as news of the capital raise were made public. Let $P_{B,I}$ denote the price per share attributable to pre-IPO shareholders before the offering but conditional on the IPO moving ahead. Formally,

$$P_{B,I} = \frac{C_B \times M + i \times S_P \times OP \times [M-1] - D_B}{S_B} = P_B + \frac{i \times S_P \times OP \times [M-1]}{S_B} \tag{7}$$

The second part of expression (7) reflects the improvement in equity value due to the capital raise since the capital raise allows investment in positive net present value projects (M>1) that was not possible without the extra capital. The price per share post IPO, P_A, can now be defined as:

$$P_A = \frac{P_{B,I} \times S_B + S_P \times OP}{S_B + S_P} \tag{8}$$

It should be noted that expression (8) is identical to expression (2) except the first term in the numerator is $P_{B,I}$ rather than P_B. Rearranging, one can solve for $P_{B,I}$. Formally,

$$P_{B,I} = P_A + \frac{S_P}{S_B} \times (P_A - OP) \tag{9}$$

This expression is equivalent to equation (3) from Barry (1989). Again, an important distinction between this analysis and Barry's is the recognition that $P_{B,I}$ represents an improvement over what would have been possible for shareholders without the capital raise. As discussed below, this improvement is needed for bargaining.

Turning to expressions (6), the second part of the expression represents dilution due to underpricing. All items on the right-hand side of expression (6) can be observed so $P_{B,I}$ can be determined precisely. It is also possible to also restate P_A in relation to P_B:

$$P_A = \frac{P_{B,I} \times S_B + S_P \times OP}{S_B + S_P} = \frac{P_B \times S_B + S_P \times OP \times (M \times i - i + 1)}{S_B + S_P} \tag{10}$$

Barry (1989) notes that total wealth loss for insiders can be broken into two parts. For shares retained, the wealth loss per share due to underpricing is given by $P_{B,I} - P_A$. For secondary shares sold in the IPO, the wealth loss per share is $P_A - OP$. Combining these, the total dollar wealth loss (wl) is:

$$wl = S_R \times \frac{S_P}{S_B} \times (P_A - OP) + S_S \times (P_A - OP) = \left[S_S + S_P - \frac{S_S \times S_P}{S_B}\right] \times (P_A - OP) \qquad (11)$$

Substitution of relation (10) into expression (11) yields the following (Appendix B shows all steps in this and other calculations below, for completeness):

$$wl = \frac{\left[S_S + S_P - \frac{S_S \times S_P}{S_B}\right]}{(S_B + S_P)} \times \left(P_B \times S_B - OP \times S_B + i \times S_P \times OP \times (M-1)\right) \qquad (12)$$

If there is a primary component to the offering, $i>0$ and $M>1$, then there is wealth gain (wg) which is the difference between $P_{B,I}$ and P_B multiplied by the pre-IPO shares. Alternatively, the wealth gain is the net present value from the capital invested from the IPO. Formally:

$$wg = i \times S_P \times OP \times [M-1] \qquad (13)$$

The net gain (ng) is simply wg - wl:

$$ng = \left\{\frac{S_B - S_S + \frac{S_S \times S_P}{S_B}}{(S_B + S_P)}\right\} \times i \times S_P \times OP \times [M-1]$$

$$- \frac{\left[S_S + S_P - \frac{S_S \times S_P}{S_B}\right]}{(S_B + S_P)} \times (P_B \times S_B - OP \times S_B) \qquad (14)$$

This expression can be used to solve for the offering price (OP^{min}) that results in no net gain for the issuer:

$$OP^{min} = \frac{(P_B \times S_B)}{S_B + \theta \times i \times S_P \times [M-1]} \qquad (15)$$

where

$$\theta = \left(\frac{S_B - S_S + \frac{S_S \times S_P}{S_B}}{S_S + S_P - \frac{S_S \times S_P}{S_B}} \right) \tag{16}$$

One can also solve for first day returns in terms of P_B:

$$UPR = \frac{S_B \times (P_B - OP) + i \times S_P \times OP \times [M - 1]}{OP \times (S_B + S_P)} \tag{17}$$

Using this expression, one can solve for the offer price that leads to zero first day returns, which I will denote as the maximum offer price (OP^{max})

$$OP^{max} = \frac{S_B \times P_B}{S_B - i \times S_P \times [M - 1]} \tag{18}$$

It is interesting to note that if M>1 and i>0, and S_P is sufficiently large relative to S_B, there will be <u>no positive offer</u> price that leads to zero underpricing. In all other cases the zero underpricing offer price will be some level *above* P_B.

Comparing the zero net gain offer price in expression (15) to the zero underpricing offer price in expression (18), the former is always less than the latter (since θ must be positive, the denominator for the zero net gain offer price must be larger than the denominator for the zero underpricing offer price) and the two values straddle P_B. When M equals 1 or i=0, the two values are equal to P_B. But as M and i grow, the spread between the two values grows around P_B, creating an opportunity to identify an offer price that is attractive to pre-IPO shareholders *and* new investors.

I now can establish a critical proposition related to the primary share adjustment puzzle:

Proposition 1: If an offer price is selected above OP^{min}, the price leading to zero net gain for issuers, changes to primary shares has a positive effect on IPO underpricing, holding other factors constant. Changes to the number of secondary shares sold has no impact on underpricing.

Proof: See Appendix B.

A model that accounts for the value added by capital raised in an IPO and considers pricing to emerge from bargaining over gains from that capital raise between issuer and investors can explain the puzzling positive effect of primary share adjustments on first day returns. It also is consistent with the evidence that secondary share adjustments have no effect on first day returns. Neither of these two relations were predicted by information and agency theories typically argued to be most important in explaining the partial price adjustment phenomenon (see Ljungqvist, 2007 and Lowry, Michaely and Volkova, 2017).

In addition to addressing the primary share adjustment puzzle, any explanation of IPO pricing should make predictions consistent with important empirical relations uncovered in the IPO literature in order to be plausible. Here I consider two important long-standing relations. First, most studies of IPO pricing include proxies for ex ante firm valuation uncertainty. While different studies use different measures, the literature finds that ex ante firm valuation uncertainty is significantly positively related to IPO underpricing. Second, as noted previously, price adjustments have a very strong statistical and economic impact on first day returns.

First, I consider the impact of ex ante valuation uncertainty on first day returns. While my analysis does not consider uncertainty with respect to input parameters, M reflects issuer growth prospects. Empirically, most of the proxies used to reflect ex ante firm valuation uncertainty could also be considered proxies for growth opportunities. Given this, it is important that my analysis predicts a positive relation between M and first day returns. Inspection of relation (17) reveals that first day returns are positively related to M.[3] An analysis that recognized the value added through

[3] The variable M has direct impact on first day returns in equation (17) but also has an indirect impact. The equity price before the IPO, P_B, is also impacted by M. Since M positively impacts P_B, the indirect impact of M on first day returns will be positive.

investment of IPO proceeds can also, therefore, predict the positive relation typically found between issuer growth prospects and first day returns.[4]

Next, I consider the partial adjustment effect. Price adjustments are likely to arise as information about growth prospects (*M*) changes. To examine the impact of changes to M on first day returns, I need additional assumptions regarding what price emerges from bargaining. I consider a special case where the issuer sets and adjusts following the pricing rule: $OP = P_B \times Z.$ One special case is Z=1 in which case the issuer sets the price equal to the price per share assuming the IPO does not proceed. This assumption is a reasonable starting point in that there is evidence that issuers anchor offer prices on pre-capital raise valuations (see Dittmar, Duchin, and Zhang, 2020). Allowing Z to vary from 1 allows us to consider other pricing rules. My only assumption, initially, is that Z is fixed through the offering process. With a fixed *Z*, changes to *M* will drive pricing changes which lead to different first day returns. To see the impact of this fixed pricing rule, I substitute it into expression (17). When doing so, first day returns simplify to the following:

$$UPR = \frac{S_B \times (1 - Z) + i \times S_P \times [M - 1]}{(S_B + S_P)} \tag{19}$$

From this expression I can establish a second important proposition:

Proposition 2: If the issuer follows a pricing rule where the offer price is some fixed fraction of the value of equity before the capital raise and the net present value multiplier for new projects is similar to the net present value multiplier for pre-IPO projects, increase (decreases) to this multiplier will result in pricing leading to higher (lower) first day returns.

Proof: See Appendix B

[4] As a direct proxy for *M*, we include, in unreported analyses, the Fama-French 48 industry market-to-book ratio in models of IPO pricing (see http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). Consistent with expectations, this variable has a significantly positive impact on first day returns.

In other words, a bargaining model recognizing gains from IPO proceed investment, can be used to explain the partial adjustment effect. When good news arises, prices likely adjust in ways that result in higher first day returns. It's important to note that the bargaining model is agnostic as to the reason M changes. The value of growth prospects can change based on firm specific information or market wide factors. The bargaining model is, therefore, consistent with evidence of partial adjustment to both public and private information.

The discussion above assumed Z remained fixed through the issue process. It is plausible, however, that Z changes based on changes to the relative bargaining power of issuers and investors through the issuance process. Any information that changes views of growth prospects also likely changes the relative bargaining power of issuers and investors. At higher levels of M, bargaining power tilts from the issuer to new investors as the external resources needed to pursue opportunities become more critical. So, as M increases (decreases), the issuer is likely to decrease (increase) Z so that more (less) of the net gains go to new investors. Inspection of expression (19) reveals that underpricing is negatively related to Z. So as Z declines, underpricing increases. Thus, as M increases, Z likely falls and first day returns increase at an increasing rate. As M falls, Z likely increases and first day returns decline at a declining rate. These predictions are highly consistent with longstanding empirical patterns.

5. Conclusions

In their review article of the IPO literature, Lowry, Michaely and Volkova (2017) identify information production / revelation and agency arguments as the most important competing explanations for the partial price adjustment phenomenon. They note that evidence is not entirely consistent with either explanation and conclude by arguing that understanding what drives partial adjustment is "an immensely important issue" (see Section 4.4 of their review). In this paper I consider a different adjustment that arises quite frequently in the IPO process. In almost 60% of IPOs the primary shares offered differs from what was indicated when the issuer first identified a price range and number of shares to be offered in an earlier filing. In 15% of IPOs, the secondary shares offered also differ from what was initially filed. While substantial attention has been directed at understanding price adjustments, few studies have explored the impact of share adjustments on IPOs.

I begin by developing predictions regarding the impact of primary and secondary share adjustments on first day returns using the two theories most prominently considered in explaining price adjustments. I posit that both information production / revelation theories and agency-based arguments would lead to a prediction that share (both primary and secondary) adjustments should lead to lower first day returns, all else equal. I then empirically examine the impact of share adjustments on IPO initial returns. I begin with an OLS regression approach. Controlling for measures commonly used to explain first day return including price adjustments, I find that secondary share adjustments have no impact on IPO first day returns and primary share adjustments have a statistically significantly positive impact. The latter effect is economically meaningful. A one standard deviation increase in primary share adjustments leads to a 2% increase in first day returns, which is approximately 13% of the sample mean. While there is a strong relation between share adjustments and first day return, causation is more challenging to establish. I consider subsamples of IPO where the independent effect of share adjustments are more plausibly identified and find similar results. I also use a matching approach where every firm increasing primary shares is matched with a non-primary share increasing issuer on dimensions known to impact pricing, including price adjustments. Using this matched sample, I find that IPOs increasing primary shares have a 5.7% higher first day return. Overall, I conclude that the positive impact of primary share adjustment on first day returns is robust. Since neither theory argued to be most important in explaining the partial price adjustment phenomenon predicts such a relation, I refer to this evidence as the IPO share adjustment puzzle.

To explain this puzzle, I introduce an explanation for IPO pricing that considers bargaining between issuers and new investors over gains arising because IPO proceeds can be invested in value adding projects. Consistent with the empirical evidence I show that as long as pricing is such that both issuers and investors realize net gains, changes to primary shares offered should lead to higher first day returns. Importantly, the arguments leading to this prediction also can be used to explain other important empirical IPO underpricing patterns including the positive effect of ex ante uncertainty proxies on first day returns and the partial price adjustment phenomenon.

As in any study, there are limitations and extensions that should be highlighted. First, while I believe the matching process allows for strong evidence regarding the incremental impact of primary share adjustments on IPO first day returns, I acknowledge that there could be some important unobservable driving the relations. Future work could pursue different strategies to identify exogenous variation in share adjustments (e.g., Dambra, Gustafson, and Pisciotta, 2021). Second, I acknowledge that the bargaining arguments in this study lack prescriptive properties. I simply restrict the range of pricing options to include those where both issues and investors gain from the IPO. A theory that proposes specific pricing and share selections emerging from an optimization could yield richer testable implications.

References

Ang, J., Brau, J., 2003. Concealing and confounding adverse signals: insider wealth-maximizing behavior in the IPO process. Journal of Financial Economics 67, 149-172.

Baron, D., 1982. A Model of the demand for investment banking advising and distribution services for new issues. Journal of Finance 37, 955–976.

Barry, C., 1989. Initial Public Offering Underpricing: The Issuer's View-A Comment. Journal of Finance 44, 1099-1103.

Benveniste, L.M., Spindt, P.A., 1989. How investment bankers determine the offer price and underwriting amount of new issues. Journal of Financial Economics 24, 343–361.

Bradley, D, Jordan, B., 2002. Partial adjustment to public information and IPO underpricing. Journal of Financial and Quantitative Analysis 37, 595-616.

Brau, J., Li, M., Shi, J., 2007. Do secondary shares in the IPO process have a negative effect on aftermarket performance? Journal of Banking & Finance 31, 2612-2631.

Caliendo, M., Kopeinig, S., 2008. Some Practical Guidance for the Implementation of Propensity Score Matching. Journal of Economic Surveys 22, 31-72.

Carter, R., Manaster, S., 1990. Initial Public Offerings and Underwriter Reputation. Journal of Finance 45, 1045–1067.

Dambra, M., Gustafson, M., Pisciotta, K., 2021. What is the effect of an additional dollar of IPO proceeds? Journal of Corporate Finance 66, 101795.

Dittmar, A., Duchin, R., Zhang, S., 2020. The timing and consequences of seasoned equity offerings: A regression discontinuity approach. Journal of Financial Economics 138, 254-276.

Dunbar, C., King, M., 2023. Syndicate structure and IPO outcomes: The impact of underwriter roles and syndicate concentration, Journal of Corporate Finance 79, 102382

Edelen, R., Kadlec, G., 2005. Issuer Surplus and the Partial Adjustment of IPO Prices to Public Information. Journal of Financial Economics 77, 347-373.

Ellis, K., Michaely, R., Ohara, M., 2000. When the Underwriter Is the Market Maker: An Examination of Trading in the IPO Aftermarket. Journal of Finance 55, 1039-1074.

Hanley, K., 1993. The Underpricing of Initial Public Offerings and the Partial Adjustment Phenomenon. Journal of Financial Economics 34, 231-250.

Ljungqvist, A., 2007. IPO Underpricing. Chapter 7 in Handbook of Corporate Finance: Empirical Corporate Finance, Vol.1. Edited by B. Espen Eckbo. 375-422

Ljungqvist, A., Wilhelm, W., 2003. IPO Pricing in the Dot-com Bubble. Journal of Finance 58,723-752.

Ljungqvist, A., Wilhelm, W., 2005. Does Prospect Theory Explain IPO Market Behavior? Journal of Finance 60, 1759-1790.

Loughran, T., Ritter, J., 2002. Why Don’t Issuers Get Upset About Leaving Money on the Table in IPOs? Review of Financial Studies 15, 413-444.
Lowry, M., Michaely, R., Volkova, E., 2017. Initial Public Offerings: A Synthesis of the Literature and Directions for Future Research. Foundations and Trends in Finance 11, 154-320.

Lowry, M., Schwert, G., 2004. Is the IPO Pricing Process Efficient? Journal of Financial Economics 71, 3-26.

Rock, K., 1986. Why New Issues Are Underpriced. Journal of Financial Economics 15, 187-212.

Sherman, A., Titman, S., 2002. Building the IPO Order Book: Underpricing and Participation Limits with Costly Information. Journal of Financial Economics 65, 3-29.

Zheng, F., 2012. Information precision and IPO pricing. Journal of Corporate Finance 18, 331-348.

Appendix A- Variable Definitions

Independent Variables

Log of Filing Size	IPO filing size equals the number of shares to be sold (primary and secondary), excluding overallotments, in millions multiplied by the average of the high and low filing price. This amount is then multiplied by the consumer price index as of the end of the month before the date when the price range is first disclosed (using the CPI series that is scaled to equal one in January 2015). This variable is then the natural logarithm of IPO filing size. ***Source***: TFSDC New Issues Database confirmed by examining IPO prospectuses (EDGAR). Inflation (CPI) data are from the Federal Reserve Bank of St. Louis website: http://research.stlouisfed.org/fred2/series/CPALTT01USM661S.
Log of LTM Revenues	We identify the last 12 months' revenue in millions for each IPO issuer (prior to offering date) multiplied by the US consumer price index as of the end of the month before the offering date (using the CPI series that is scaled to equal one in January 2015). This variable is then the natural logarithm of 1+ LTM revenues in millions. ***Source***: Compustat. When data are not available, sales are obtained from the initial IPO prospectus (EDGAR). Inflation (CPI) data are from the Federal Reserve Bank of St. Louis website: http://research.stlouisfed.org/fred2/series/CPALTT01USM661S.
Log of Firm Age	Corporate founding date (year) is obtained from Jay Ritter's website. Issuer age at the time of the IPO is the year of the IPO subtract the founding year. The log of issuer age is the logarithm of one plus issuer age. ***Source***: Jay Ritter's website: https://site.warrington.ufl.edu/ritter/ipo-data/
Log of Firm Assets	We identify total assets in millions for each IPO issuer (prior to offering date) multiplied by the US consumer price index as of the end of the month before the offering date (using the CPI series that is scaled to equal one in January 2015). This variable is then the natural logarithm of firm assets in millions. ***Source***: Compustat. When data are not available, sales are obtained from the initial IPO prospectus (EDGAR). Inflation (CPI) data are from the Federal Reserve Bank of St. Louis website: http://research.stlouisfed.org/fred2/series/CPALTT01USM661S.
Log of Long-Term Debt	We identify total long-term debt in millions for each IPO issuer (prior to offering date) multiplied by the US consumer price index as of the end of the month before the offering date (using the CPI series that is scaled to equal one in January 2015). This variable is then the natural logarithm of firm long-term debt in millions. ***Source***: Compustat. When data are not available, sales are obtained from the initial IPO prospectus (EDGAR). Inflation (CPI) data are from the Federal Reserve Bank of St. Louis website: http://research.stlouisfed.org/fred2/series/CPALTT01USM661S.
Private Equity Backed Dummy	A dummy variable that equals one if the IPO had prior private equity backing, and zero otherwise. Source: TFSD New Issues database
Venture Capital Backed Dummy	A dummy variable that equals one if the IPO had prior venture capital backing, and zero otherwise. Source: TFSD New Issues database

Lead-Left LTM Market Share	This variable measures underwriter market share for the lead-left over the last twelve months (LTM) based on equal credit to each lead manager. It is defined as the value (CPI adjusted proceeds) of all IPOs over the 12 months prior to the IPO issue date managed by the underwriter based on equal credit to lead managers divided by the total dollars raised (CPI adjusted proceeds) over that period. CPI adjusted proceeds are defined as the gross proceeds on an IPO multiplied by the consumer price index as of the end of the month before the offering date using the CPI series scaled to 1 in January 2010 (http://research.stlouisfed.org/fred2/series/CPALTT01USM661S). If an underwriter merged during the 12-month period, the value of IPOs managed by pre-merger underwriters is also included in the numerator. Sources: IPO proceeds are from TFSDC New Issues database confirmed through searches of IPO prospectuses (on EDGAR). Underwriters and their roles and underwriting amount are identified using TFSDC New Issues Database and confirmed through prospectus searches on the SEC EDGAR system database. TFSDC's merger and acquisitions database is used to account for underwriter mergers.
Lead-Left Carter Manaster Rank	This variable is the Carter-Manaster (Carter and Manaster, 1990) reputation ranking on a scale of 0 to 9.001 for the lead-left underwriter at the time of the IPO. Source: Rankings are obtained from Jay Ritter's website (see the link to "IPO Underwriter Reputation Rankings (1980-2021)" at https://site.warrington.ufl.edu/ritter/ipo-data/). Jay Ritter provides rankings for each underwriter which can differ depending on the time period. We use the ranking for the underwriter during the period that corresponds to the IPO date.
Overhang based on filing terms	Ratio of shares retained to shares offered based on terms as of the first pricing date. Share retained equals shares pre-IPO (for issuers with multiple share classes, this is the sum of shares across all share classes) less secondary shares proposed to be sold in the initial filing. Shares to be offered is the sum of primary and secondary shares proposed from the initial filing. Source: Primary and secondary shares filed from TFSD New Issues database confirmed through search of IPO prospectuses (EDGAR). Number of shares pre-IPO is the number of shares post-IPO less primary shares in the IPO from the final prospectus (EDGAR). Number of shares post-IPO is from the Center for Research in Security Prices (CRSP) with adjustments to account for multiple share classes, from Jay Ritter's website (see https://site.warrington.ufl.edu/ritter/files/founding-dates.pdf).
Nasdaq Composite Return 30 days pre first pricing	The return, in percent, over the 30 days ending the date the issuer first files a price range amendment, on the Nasdaq Composite index. Source: the first pricing date is from the TFSDC New Issues Database and confirmed through prospectus searches on the SEC EDGAR system database and the index return is from CRSP.
Fama-French 48 Industry Return 30 Days Pre-First Pricing	The return, in percent, over the 30 days ending the date the issuer first files a price range amendment, on the Fama-French portfolio formed of firms in the same industry as the IPO, using the Fama-French 48 industry classification scheme. Source: the first pricing date is from the TFSDC New Issues Database and confirmed through prospectus searches on the SEC EDGAR system database and the industry return is from Ken French's website (https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html)

Fama-French 48 Industry Market-to-Book at First Pricing	The industry book to market ratio as of December 31 the year prior to IPO filing is obtained for each issuer, using the Fama-French 48 industry classification scheme. This variable is then the inverse of the book-to-market ratio. Source: the first pricing date is from the TFSDC New Issues Database and confirmed through prospectus searches on the SEC EDGAR system database and the industry return is from Ken French's website (https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html)
Log of IPO Capital Raised LTM at First Pricing	We first identify all IPOs that occurred in the 12 months prior to the first pricing date in this IPO. For all those IPOs we measure the proceeds raised (then umber of shares sold, primary and secondary excluding overallotments, in millions multiplied by offering price). This amount is then multiplied by the consumer price index as of the end of the month before the date of that IPO (using the CPI series that is scaled to equal one in January 2015). We sum the CPI adjusted proceeds for all IPOs in the prior 12 months and this variable is then the natural logarithm of that sum. Source: TFSDC New Issues Database confirmed by examining IPO prospectuses (EDGAR). Inflation (CPI) data are from the Federal Reserve Bank of St. Louis website: http://research.stlouisfed.org/fred2/series/CPALTT01USM661S.
Nasdaq Composite Return first pricing to offering	The return, in percent, from either the IPO first pricing date to offering date or over the 30 days prior to the offering if the first pricing date is more than 30 days prior to the IPO, on the Nasdaq Composite index. Source: the first pricing date is from the TFSDC New Issues Database and confirmed through prospectus searches on the SEC EDGAR system database and the index return is from CRSP.
Fama-French 48 Industry Return First Pricing to Offering	The return, in percent, from either the IPO first pricing date to offering date or over the 30 days prior to the offering if the first pricing date is more than 30 days prior to the IPO, on the Fama-French portfolio formed of firms in the same industry as the IPO, using the Fama-French 48 industry classification scheme. Source: the first pricing date is from the TFSDC New Issues Database and confirmed through prospectus searches on the SEC EDGAR system database and the industry return is from Ken French's website (https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html)
Price and Share Adjustments	
Total Price Adjustment	100 x (offer price - average of high and low prices on the offering date) / average filing price. ***Source***: TFSDC New Issues Database confirmed by examining IPO prospectuses (EDGAR) for offering price and filing prices
Price Adjustment if Negative	This equals Total Price Adjustment if it is negative and zero otherwise
Price Adjustment if Positive	This equals Total Price Adjustment if it is positive and zero otherwise
Primary Share Adjustment	100 x (primary shares offered - primary shares proposed in initial filing) / total shares proposed in the initial filing. Source: TFSDC New Issues Database confirmed by examining IPO prospectuses (EDGAR) for offering price and filing prices
Secondary Share Adjustment	100 x (secondary shares offered - secondary shares proposed in initial filing) / total shares proposed in the initial filing. Source: TFSDC New Issues Database confirmed by examining IPO prospectuses (EDGAR) for offering price and filing prices
IPO outcome	
First-Day Return	100 x (first trading day opening price - offering price) / offering price. ***Source***: TFSDC New Issues Database confirmed by examining IPO prospectuses (EDGAR) for offering price. CRSP for first trading day opening price

Appendix B - Shares Offered, Bargaining and First Day Returns

In this appendix, I present detailed calculations leading to all expressions in Section 4 of the paper. I also provide proofs of the two propositions from that section. To allow this appendix to be read without reference to the paper, I begin by again defining key variables (using the same labels as in the paper):

S_B = the number of shares outstanding before the IPO

S_S = the number of pre-IPO (or "secondary") shares to be sold in the IPO by pre-IPO shareholders.

S_P = the number of primary shares to be sold in the IPO

OP = the offering price for the IPO

EV_t = enterprise value (equity plus debt) of the firm at point t relative to the IPO (t=B if before the capital raise and t=A if after the capital raise)

D_t = debt outstanding at point t relative to the IPO

E_t= the total value of equity at point t relative to the IPO (note: $E_t = EV_t - D_t$)

M = NPV % multiplier for capital raised in the IPO, net of direct issuance costs (M=1 if market value equals net capital raised)

i = the percentage of the IPO proceeds used to invest in new projects (the remaining proceeds will be used to retire debt)

Let P_B equal the value per share before the IPO is contemplated given E_B. Formally,

$$P_B = \frac{E_B}{S_B} \qquad (B1)$$

If I define C_B as the capital available to be invested pre-IPO, one special case I will consider is the situation where $EV_B = C_B \times M$. Below I will consider what happens as M changes through the registration process and this enterprise value relation assumes that news resulting in a y% change in the valuation of new projects to be invested in with IPO proceeds will also result in a y% change in valuation of exiting projects. Given these definitions it is possible to identify the enterprise value that would emerge after the IPO, labeled EV_A. formally:

$$EV_A = EV_B + i \times S_P \times OP \times M = C_B \times M + i \times S_P \times OP \times M \qquad (B2)$$

Expression (B2) is the same as expression (5) in the paper. Enterprise value should increase based on the value of new capital raised in the IPO that is invested in new projects. One can also measure the total value of equity post IPO. Noting the debt after the IPO is simply the debt before the IPO less any debt retired, equity after the offer, E_A, can be defined as follows:

$$E_A = EV_A - D_A = C_B \times M + i \times S_P \times OP \times M - (D_B - S_P \times OP \times (1 - i))$$

$$E_A = (C_B \times M + i \times S_P \times OP \times [M - 1] - D_B) + S_P \times OP \qquad \text{(B3)}$$

Expression (B3) is the same as expression (6) in the paper. The first part of the expression represents the value to pre-IPO shareholders conditional on the capital raised. If the firm were public, its value should increase to the amount in parentheses as soon as news of the capital raise was made public.

Let $P_{B,I}$ denote this price per share attributable to pre-IPO shareholders before the offering but conditional on the IPO moving ahead. Formally,

$$P_{B,I} = \frac{C_B \times M + i \times S_P \times OP \times [M - 1] - D_B}{S_B} = P_B + \frac{i \times S_P \times OP \times [M - 1]}{S_B} \qquad (B4)$$

Expression (B4) is the same as expression (7) in the paper. The second part of expression (B4) reflects the improvement in equity value due to the capital raise since the capital raise allows investment in positive net present value projects (M>1) that was not possible without the extra capital. Let P_A denote the price per share after the IPO. Formally,

$$P_A = \frac{P_{B,I} \times S_B + S_P \times OP}{S_B + S_P} \qquad (B5)$$

Expression (B5) is the same as expression (8) in the paper. Rearranging one can solve for $P_{B,I}$:

$$P_{B,I} = P_A + \frac{S_P}{S_B} \times (P_A - OP) \qquad (B6)$$

Expression (B6) is the same as expression (9) in the paper. This expression is equivalent to equation (3) from Barry (1989). An important distinction between this analysis and Barry's is the recognition that $P_{B,I}$ represents an improvement over what would have been possible for shareholders without the capital raise. As discussed below, this improvement is needed for bargaining.

Turning to expressions (B6), the second part of the expression represents dilution due to underpricing. All items on the right hand side of expression (B6) can be observed so $P_{B,I}$ can be determined precisely. It is also possible to also restate P_A in relation to P_B:

$$P_A = \frac{P_{B,I} \times S_B + S_P \times OP}{S_B + S_P} = \frac{P_B \times S_B + S_P \times OP \times (M \times i - i + 1)}{S_B + S_P} \qquad (B7)$$

Expression (B7) is the same as expression (10) in the paper. Barry (1989) notes that total wealth loss for insiders can be broken into two parts. For shares retained, the wealth loss per share due to underpricing is given by $P_{B,I} - P_A$. For secondary shares sold in the IPO, the wealth loss per share is $P_A - OP$. Combining these, the total dollar wealth loss (wl) is:

$$wl = S_R \times \frac{S_P}{S_B} \times (P_A - OP) + S_S \times (P_A - OP) = \left[S_S + S_P - \frac{S_S \times S_P}{S_B}\right] \times (P_A - OP) \qquad (B8)$$

Expression (B8) is the same as expression (11) in the paper. Substitution relation (B7) into expression (B8):

$$wl = \left[S_S + S_P - \frac{S_S \times S_P}{S_B}\right] \times \left(\frac{P_B \times S_B + S_P \times OP \times (M \times i - i + 1)}{S_B + S_P} - OP\right)$$

$$wl = \frac{\left[S_S + S_P - \frac{S_S \times S_P}{S_B}\right]}{(S_B + S_P)} \times (P_B \times S_B + S_P \times OP \times (M \times i - i + 1) - OP \times S_B - OP \times S_P)$$

$$wl = \frac{\left[S_S + S_P - \frac{S_S \times S_P}{S_B}\right]}{(S_B + S_P)} \times \left(P_B \times S_B - OP \times S_B + i \times S_P \times OP \times (M-1)\right) \qquad (B9)$$

Expression (B9) is the same as expression (12) in the paper.

If there is a primary component to the offering, i>0 and M>1, then there is wealth gain (wg) which is the difference between $P_{B,I}$ and P_B multiplied by the pre-IPO shares. Alternatively, the wealth gain is the net present value from the capital invested from the IPO. Formally:

$$wg = i \times S_P \times OP \times [M-1] \qquad (B10)$$

Expression (B10) is the same as expression (13) in the paper. The net gain (ng) is simply wg - wl:

$$ng = i \times S_P \times OP \times [M-1] - \frac{\left[S_S + S_P - \frac{S_S \times S_P}{S_B}\right]}{(S_B + S_P)} \times \left(P_B \times S_B - OP \times S_B + i \times S_P \times OP \times (M-1)\right)$$

$$ng = \left\{1 - \frac{\left[S_S + S_P - \frac{S_S \times S_P}{S_B}\right]}{(S_B + S_P)}\right\} \times i \times S_P \times OP \times [M-1] - \frac{\left[S_S + S_P - \frac{S_S \times S_P}{S_B}\right]}{(S_B + S_P)} \times (P_B \times S_B - OP \times S_B)$$

$$ng = \left\{\frac{S_B - S_S + \frac{S_S \times S_P}{S_B}}{(S_B + S_P)}\right\} \times i \times S_P \times OP \times [M-1] - \frac{\left[S_S + S_P - \frac{S_S \times S_P}{S_B}\right]}{(S_B + S_P)} \times (P_B \times S_B - OP \times S_B) \qquad (B11)$$

Expression (B11) is the same as expression (15) in the paper.

This expression can be used to solve for the offering price (OP^{min}) that results in no net gain for the issuer:

$$ng = \left\{\frac{S_B - S_S + \frac{S_S \times S_P}{S_B}}{(S_B + S_P)}\right\} i \times S_P \times OP^{min} \times [M-1]$$

$$- \frac{\left[S_S + S_P - \frac{S_S \times S_P}{S_B}\right]}{(S_B + S_P)} \times \left(P_B \times S_B - OP^{,min} \times S_B\right) = 0$$

$$\left(S_B - S_S + \frac{S_S \times S_P}{S_B}\right) \times i \times S_P \times OP^{min} \times [M-1]$$

$$- \left(S_S + S_P - \frac{S_S \times S_P}{S_B}\right) \times \left(P_B \times S_B - OP^{min} \times S_B\right) = 0$$

$$OP^{min} \times \left[\left(S_B - S_S + \frac{S_S \times S_P}{S_B}\right) \times i \times S_P \times [M-1] + \left(S_S + S_P - \frac{S_S \times S_P}{S_B}\right) \times S_B\right]$$

$$= \left(S_S + S_P - \frac{S_S \times S_P}{S_B}\right) \times (P_B \times S_B)$$

$$OP^{min} = \frac{\left(S_S + S_P - \frac{S_S \times S_P}{S_B}\right) \times (P_B \times S_B)}{\left(S_B - S_S + \frac{S_S \times S_P}{S_B}\right) \times i \times S_P \times [M-1] + \left(S_S + S_P - \frac{S_S \times S_P}{S_B}\right) \times S_B}$$

$$OP^{min} = \frac{(P_B \times S_B)}{\left(\frac{S_B - S_S + \frac{S_S \times S_P}{S_B}}{S_S + S_P - \frac{S_S \times S_P}{S_B}}\right) \times i \times S_P \times [M-1] + S_B}$$

Let:

$$\theta = \left(\frac{S_B - S_S + \frac{S_S \times S_P}{S_B}}{S_S + S_P - \frac{S_S \times S_P}{S_B}}\right) \qquad (B12)$$

Expression (B12) is the same as expression (16) in the paper. The expression for the zero net gain offer price simplifies to:

$$OP^{min} = \frac{(P_B \times S_B)}{S_B + \theta \times i \times S_P \times [M-1]} \qquad (B13)$$

Expression (B13) is the same as expression (15) in the paper.

One can also solve for first day returns in terms of P_B:

$$UPR = \frac{(P_A - OP)}{OP} = \frac{P_{B,I} \times S_B + S_P \times OP \ - OP \times (S_B + S_P)}{OP \times (S_B + S_P)}$$

$$UPR = \frac{P_B \times S_B + S_P \times OP \times (M \times i - i + 1) \ - OP \times (S_B + S_P)}{OP \times (S_B + S_P)}$$

$$UPR = \frac{S_B \times (P_B - OP) + i \times S_P \times OP \times [M - 1]}{OP \times (S_B + S_P)} \qquad (B14)$$

Expression (B14) is the same as expression (17) in the paper. Using this expression, one can solve for the offer price that leads to zero first day returns, which I will denote as the maximum offer price (OP^{max})

$$UPR = \frac{S_B \times (P_B - OP^{max}) + i \times S_P \times OP^{max} \times [M - 1]}{OP^{max} \times (S_B + S_P)} = 0$$

$$S_B \times (P_B - OP^{max}) + i \times S_P \times OP^{max} \times [M - 1] = 0$$

$$OP^{max} = \frac{S_B \times P_B}{S_B - i \times S_P \times [M - 1]} \qquad (B15)$$

Expression (B15) is the same as expression (18) in the paper.

I can now prove proposition 1 from the paper. It states that if an offer price is selected above OP^{min}, the price leading to zero net gain for issuers, changes to primary shares has a positive effect on IPO underpricing, holding other factors constant. Changes to the number of secondary shares sold has no impact on underpricing.

Using expression (B14), I consider the impact of changes to primary shares on first day returns:

$$\frac{\partial UPR}{\partial S_P}$$

$$= \frac{i \times OP \times [M-1] \times OP \times (S_B + S_P) - OP \times S_B \times (P_B - OP) - i \times S_P \times OP^2 \times [M-1]}{OP^2 \times (S_B + S_P)^2}$$

$$\frac{\partial UPR}{\partial S_P} = \frac{i \times S_B \times OP \times [M-1] - S_B \times (P_B - OP)}{OP \times (S_B + S_P)^2} = \frac{S_B \times (i \times M \times OP - P_B)}{OP \times (S_B + S_P)^2}$$

This derivative is positive if $i \times M \times OP - P_B > 0$ but negative if $i \times M \times OP - P_B < 0$. I first consider a special case when the issuer selects OP^{min}, the price where the issuer realizes no net gain from issuance. Expression (B13) can be rearranged to solve for P_B in terms of OP^{min}:

$$\frac{S_B + \theta \times i \times S_P \times [M-1]}{S_B} \times OP^{min} = P_B \qquad (B16)$$

If there is no secondary component to the IPO, $S_S = 0$ and $\theta = S_B / S_P$. Substituting this into expression (B16), I find that: $i \times M \times OP^{min} = P_B$

So, at the minimum offer price resulting in non-negative net gains for the issuer, $i \times M \times OP - P_B = 0$. For any offering prices above that level, $i \times M \times OP - P_B > 0$. When there is no secondary component to the IPO, therefore, it is always the case that $\partial UPR/\partial S_P > 0$. When there *is* a secondary component, the analysis becomes more complicated. I first consider the impact on OP^{min} when the secondary component of the IPO increases. Taking the first derivative of expression (B13) with respect to S_S:

$$\frac{\partial OP^{min}}{\partial S_S} = \frac{-i \times S_P \times (M-1) \times (P_B \times S_B) \times \partial\theta/\partial S_S}{(S_B + \theta \times i \times S_P \times [M-1])^2}$$

The sign of this derivative depends on the sign of $\partial\theta/\partial S_S$. If $\partial\theta/\partial S_S$ is negative, then $\partial OP^{min}/\partial S_S$ is positive. Taking the first derivative of expression (B12) with respect to S_S:

$$\frac{\partial\theta}{\partial S_S} = \frac{(S_P - S_B) \times (S_B^2 + S_S \times S_B)}{(S_S \times S_B + S_P \times S_B + S_S \times S_P)^2}$$

This expression is negative if the number of primary shares offered is less than the number of shares outstanding prior to the IPO (which is true empirically for almost all IPOs). So as the secondary component of the IPO increases, the minimum price that results in non-negative net gains for the issuer increases. Since $i \times M \times OP - P_B > 0$ for the minimum offer price without a secondary component to the IPO, the condition must also hold at higher offer prices with a secondary. Overall, therefore, if the issuer selects an offer price such that net gains are non-negative, the effect of changes to primary shares on first day returns, holding all else equal, will be positive as argued in proposition 1.

Inspection of expression (B14) reveals that the number of secondary shares in the IPO has no impact on first day returns. This completes proof of the proposition 1 which concludes by arguing that changes to secondary shares should have no impact on first day returns.

I now provide analysis leading to proposition 2 in the paper which states the following: If the issuer follows a pricing rule where the offer price is some fixed fraction of the value of equity before the capital raise and the net present value multiplier for new projects is similar to the net present value multiplier for pre-IPO projects, increase (decreases) to this multiplier will result in pricing leading to higher (lower) first day returns.

Rearranging expression (B14) yields:

$$UPR = \frac{P_B \times S_B + S_P \times OP \times (M \times i - i + 1) - OP \times (S_B + S_P)}{OP \times (S_B + S_P)} \tag{B17}$$

Noting:

$$P_B = \frac{E_B}{S_B} = \frac{C_B \times M - D_B}{S_B}$$

And substituting this into (B17) yields:

$$UPR = \frac{C_B \times M - D_B + S_P \times OP \times (M \times i - i) + S_P \times OP - OP \times (S_B + S_P)}{OP \times (S_B + S_P)}$$

$$UPR = \frac{C_B \times M - D_B - S_B \times OP + i \times S_P \times OP \times [M - 1]}{OP \times (S_B + S_P)} \qquad (B18)$$

Taking the first derivative of UPR in expression (B18) with respect to M yields:

$$\frac{\partial UPR}{\partial M} = \frac{C_B + i \times S_P \times OP}{OP \times (S_B + S_P)} > 0$$

As noted in the paper, this result is not surprising. As M increases and the value added from existing and new projects grow, underpricing must increase if no offer terms are adjusted. I now consider a special case where the issuer sets and adjusts prices in a specific way. Specifically, suppose the issuer follows the following pricing rule: $OP = P_B \times Z.$ Substituting this pricing rule into the statement for UPR, expression (B18):

$$UPR = \frac{C_B \times M - D_B - S_B \times Z \times \frac{C_B \times M - D_B}{S_B} + i \times S_P \times Z \times \frac{C_B \times M - D_B}{S_B} \times [M - 1]}{\frac{C_B \times M - D_B}{S_B} \times Z \times (S_B + S_P)}$$

$$UPR = \frac{(C_B \times M - D_B) \times (1 - Z) + i \times S_P \times \frac{C_B \times M - D_B}{S_B} \times [M - 1]}{\frac{C_B \times M - D_B}{S_B} \times (S_B + S_P)}$$

Multiplying top and bottom by S_B and dividing to and bottom by $(C_B \times M - D_B)$ I obtain

$$UPR = \frac{S_B \times (1 - Z) + i \times S_P \times [M - 1]}{(S_B + S_P)} \qquad (B19)$$

Expression (B19) is the same as expression (19) in the paper.

To prove proposition 2 in the paper, I simply take the derivative of UPR with respect to M:

$$\frac{\partial UPR}{\partial M} = \frac{i \times S_P}{(S_B + S_P)} > 0$$

As posited in proposition 2, if the issuer follows a pricing rule where the offer price is some fixed fraction of the value of equity before the capital raise and the net present value multiplier for new projects is similar to the net present value multiplier for pre-IPO projects, increase (decreases) to this multiplier will result in pricing leading to higher (lower) first day returns.

In the final part of Section 4 in the paper I discuss implications of changing the pricing rule. To see these effects, I simply need to take the first derivative of UPR in expression (B19) with respect to *Z*:

$$\frac{\partial UPR}{\partial Z} = \frac{-S_B}{(S_B + S_P)} < 0$$

As argued in Section 4, decreases to Z, which result in a greater share of net gains from the IPO to new investors, have a positive effect on first day returns.

Table 1: Price and Size Adjustments in U.S. IPOs, 2002-2020

In Panel A, I report IPO counts and percentages broken down by whether shares (primary and/or secondary) offered are increased, decreased or unchanged from the firm's initial filing. The counts are further broken down by whether the final price is less than the low price indicated in the first pricing range (price below range), above the high price from the initial pricing range (price above range) or in between the low and high filing price (price in range). Percentages are based on total counts in each column. IPOs labeled as having share movements not inconstant include all IPOs except cases where primary share increase and secondary shares decrease or primary shares decrease and secondary shares increase. In Panel B, I report sample means for first-day returns (as defined in Appendix A) for different groups of IPOs based on share and price adjustments. The total sample includes all U.S. firm commitment IPOs issued between 2002 and 2020 from the Thomson Financial SDC New Issues database (original IPOs). We exclude closed end funds, REITs, limited partnerships, unit investment trusts, unit offerings, issues by banks, American depositary receipts, American depositary shares, global depositary receipts, and global depositary shares. We also exclude, offerings with offer prices below $5 and proceed below $10 million (CPI adjusted), pure secondaries based on filing or offering terms (i.e., no proceeds are raised by the issuing company), offerings that do not have a positive price range (i.e., the low and high filing prices are equal) and offerings not listing on the American Stock Exchange, Nasdaq, or NYSE. Offerings are excluded if aftermarket trading data is not available on the Center for Research in Security Prices (CRSP).

	Price below range	**Price in Range**	**Price above range**
Panel A: IPO Counts and Percentages			
Primary shares decrease	130	105	53
	19.7%	***11.8%***	***10.6%***
Primary shares no change	278	454	202
	42.2%	***51.1%***	***40.6%***
Primary shares increase	251	330	243
	38.1%	***37.1%***	***48.8%***
Secondary shares decrease	111	25	18
	16.8%	***2.8%***	***3.6%***
Secondary shares no change	535	806	402
	81.2%	***90.7%***	***80.7%***
Secondary shares increase	13	58	78
	2.0%	***6.5%***	***15.7%***
Primary increase, Secondary decrease	73	14	15
	11.1%	***1.6%***	***3.0%***
Primary decrease, Secondary increase	7	22	24
	1.1%	***2.5%***	***4.8%***
Share movements not inconsistent	579	853	459
	87.9%	***96.0%***	***92.2%***
Total	659	889	498
Panel B: IPO First-Day Returns Averages			
Primary shares decrease	0.18	4.97	35.00
Primary shares no change	2.20	8.64	38.26
Primary shares increase	3.40	15.35	44.38
Secondary shares decrease	2.53	8.63	37.30
Secondary shares no change	2.24	10.78	41.78
Secondary shares increase	0.76	10.36	37.18

Table 2 – Descriptive Statistics for 2046 IPOs between 2002 and 2020

This table reports sample means, medians and standard deviations for all independent variables used in the study. The sample includes all U.S. firm commitment IPOs issued between 2002 and 2020 from the Thomson Financial SDC New Issues database (original IPOs). We exclude closed end funds, REITs, limited partnerships, unit investment trusts, unit offerings, issues by banks, American depositary receipts, American depositary shares, global depositary receipts, and global depositary shares. See Table 1 for other details on IPO sample construction. Definitions for each measure are provided in Appendix A.

	Mean	Median	Standard Deviation
Market Conditions			
Nasdaq Composite Return 30 days pre first pricing	5.76	5.10	9.42
Nasdaq Composite Return first pricing to offering	0.57	0.82	3.39
Fama-French 48 Industry Return 30 Days Pre-First Pricing	1.89	1.98	4.50
Fama-French 48 Industry Return first pricing to offering	0.46	0.62	3.54
Log of IPO Capital Raised LTM at First Pricing	10.26	10.37	0.44
Issuer/Issue Characteristics			
Log of Filing Size	4.89	4.70	0.93
Log of LTM Revenues	4.09	4.48	2.47
Log of Firm Age	2.52	2.40	0.88
Log of Firm Assets	4.92	4.69	1.97
Log of Long-Term Debt	2.73	2.18	2.65
Private Equity Backed Dummy	0.29	0.00	0.45
Venture Capital Backed Dummy	0.49	0.00	0.50
Overhang based on filing terms	3.69	3.15	2.69
Underwriter Reputation			
Lead-Left LTM Market Share	7.57	8.52	5.12
Lead-Left Carter Manaster Rank	8.11	8.50	1.52
Price and Share Adjustments			
Total Price Adjustment	-3.55	0.00	20.51
Price Adjustment if Negative	-9.55	0.00	13.89
Price Adjustment if Positive	6.00	0.00	10.62
Primary Share Adjustment	5.22	0.00	16.85
Secondary Share Adjustment	-0.24	0.00	8.17

Table 3- First Day Returns

This table reports estimates of ordinary least squares models of IPO first day returns. All models include control variables (defined in Appendix A) as well as time and industry dummy variables (time variables reflect are based on the 3 months starting January 2002 when an IPO first begins trading and industry variables are based on Fama-French 10 industry classification; see https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.htm). I report coefficient estimates and p-values. Significant variables at the 10% level or better are reported in bold font. The sample for model (1) includes all U.S. firm commitment IPOs issued between 2002 and 2020 from the Thomson Financial SDC New Issues database (original IPOs). See Table 1 for details on IPO sample construction. Model (2) excludes all IPOs priced above the high price from the initial filing range that also increase primary shares. Model (3) only includes IPOs where the offer price is greater than or equal to the low price from the initial filing range and less than or equal to the high price from the initial filing range.

	(1)		**(2)**		**(3)**	
Sample:	**All IPOs**		**Exclude IPO priced above range that increase primary shares.**		**Only IPOs priced in the range.**	
Market Conditions						
Nasdaq Composite Return 30 days pre first pricing	-0.011	0.830	-0.023	0.627	0.061	0.348
Fama-French 48 Industry Return 30 Days Pre-First Pricing	**0.338**	**0.001**	**0.277**	**0.002**	**0.253**	**0.034**
Nasdaq Composite Return first pricing to offering	0.131	0.483	0.082	0.625	0.039	0.858
Fama-French 48 Industry Return first pricing to offering	0.228	0.179	0.163	0.290	0.063	0.765
Log of IPO Capital Raised LTM at First Pricing	3.962	0.150	1.645	0.503	1.607	0.674
Issuer/Issue Characteristics						
Log of Filing Size	0.352	0.637	0.255	0.709	-1.085	0.245
Log of LTM Revenues	0.159	0.652	0.282	0.396	0.462	0.278
Log of Firm Age	0.120	0.840	-0.068	0.899	0.586	0.417
Log of Firm Assets	-0.187	0.678	-0.286	0.493	-0.453	0.368
Log of Long-Term Debt	**-0.558**	**0.028**	**-0.576**	**0.015**	-0.210	0.519
Private Equity Backed Dummy	0.703	0.579	0.200	0.862	-0.533	0.737
Venture Capital Backed Dummy	**3.641**	**0.003**	**3.147**	**0.005**	-0.679	0.640
Overhang based on filing terms	**0.652**	**0.000**	**0.537**	**0.001**	0.161	0.363
Underwriter Reputation						
Lead-Left LTM Market Share	0.076	0.476	0.105	0.276	**0.231**	**0.067**
Lead-Left Carter Manaster Rank	0.601	0.105	0.435	0.189	-0.242	0.574
Price and Share Adjustments						
Price Adjustment if Negative	**0.183**	**0.000**	**0.166**	**0.000**	**0.617**	**0.000**
Price Adjustment if Positive	**1.165**	**0.000**	**1.081**	**0.000**	**1.377**	**0.000**
Primary Share Adjustment	**0.117**	**0.000**	**0.108**	**0.000**	**0.164**	**0.000**
Secondary Share Adjustment	-0.015	0.759	0.009	0.838	-0.105	0.169
Constant	-40.592	0.174	-12.383	0.642	-10.389	0.805
Observations	2,046		1,803		889	
Adjusted R^2	0.481		0.430		0.204	

Table 4- Propensity Score Matching Analysis

In Model (1) I present estimates from a Probit model where the dependent variable equals 1 if the primary shares offered is greater than that in the initial filing, and 0 otherwise. See Table 1 for details on sample construction. I report coefficient p-values and marginal effects, which represent effects on the probability of primary share increases from changes in independent variables. For continuous variables, marginal effect is defined as $\phi(\beta x)*\beta*\sigma_x$ where $\phi()$ is the standard normal probability density function, β is the coefficient estimate, x is the mean of the independent variable for the sample, and σ_x is one standard deviation for the independent variable. For dichotomous variables, marginal effect is the change in probability when changing the variable from 0 to 1 (every other variable measured at its mean). See Table 1 for details on IPO sample construction. Model (2) reports ordinary least squares estimates from a model where the dependent variable is the IPO first day return. I report coefficient estimates and p-values which are based on robust standard errors clustered by offering. The analysis here examines a sample of IPOs emerging from propensity score matching analysis. We use Probit model (1) below to identify best matches for each IPO increasing primary shares. We use one-to-one matching with replacement where propensity scores must be within 1%. We drop IPOs increasing primary shares without viable matches and those for which there is no "common support" (i.e., we drop IPOs where the propensity score for the firm increasing primary shares is greater than the maximum or less than the minimum of all IPOs not increasing primary shares). The final sample consists of 804 issuers increasing primary shares and 804 matches. Independent variables in both models are defined in Appendix A. Model (2) includes an additional variable (***Dummy =1 if Primary Shares Increase***) which equals one if primary shares offered exceed the number first filed. Significant variables at the 10% level or better are reported in bold font. While not reported the model includes time and industry fixed effects (dummy variables for each of the 76 quarters covered by the sample period and for each industry based on Fama and French's 10 industry classification; see https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.htm). Pseudo- R squared is reported for model (1) and adjusted R -squared is reported for models (2).

	(1)		**(2)**	
	Marginal Effect	**P-value**	**Coefficient**	**P-value**
Market Conditions				
Nasdaq Composite Return 30 days pre first pricing	**-2.432**	**0.095**	0.093	0.209
Fama-French 48 Industry Return 30 Days Pre-First Pricing	1.099	0.391	**0.322**	**0.022**
Nasdaq Composite Return first pricing to offering	-0.457	0.804	0.431	0.108
Fama-French 48 Industry Return first pricing to offering	2.126	0.225	-0.037	0.879
Log of IPO Capital Raised LTM at First Pricing	1.429	0.669	-0.276	0.938
Issuer/Issue Characteristics				
Log of Filing Size	-0.953	0.640	0.410	0.730
Log of LTM Revenues	**-5.312**	**0.036**	-0.219	0.658
Log of Firm Age	0.506	0.742	0.627	0.433
Log of Firm Assets	-1.445	0.579	0.600	0.402
Log of Long-Term Debt	**5.867**	**0.004**	**-0.985**	**0.021**
Private Equity Backed Dummy	0.187	0.960	1.511	0.366
Venture Capital Backed Dummy	2.559	0.475	2.374	0.233
Overhang based on filing terms	-2.510	0.100	**0.934**	**0.042**
Underwriter Reputation				
Lead-Left LTM Market Share	**-2.894**	**0.078**	-0.052	0.699
Lead-Left Carter Manaster Rank	0.644	0.696	0.423	0.353
Price and Share Adjustments				
Price Adjustment if Negative	**-2.906**	**0.030**	**0.117**	**0.001**
Price Adjustment if Positive	**9.368**	**0.000**	**1.353**	**0.000**
Dummy = 1 if Primary Shares Increase			**5.652**	**0.000**
Constant			37.790	0.463
Observations	2,046		1,608	
Adj R^2 / Pseudo R^2	0.139		0.585	

Table 5: Independent Variable Comparison for U.S. IPOs Increasing vs. Not Increasing Primary Shares Pre and Post Propensity Score Matching

This table presents summary statistics for independent variables, broken down by whether the issuer increases primary shares (i.e., primary shares offered is greater than that indicated in the initial filing) or not. I report means for variables (detailed definitions for each measure are provided in Appendix A) broken down by whether the issuer ultimately increases primary shares or not. P-values are provided based a t-test of equality of means for the two groups of issuers (using robust standard errors). For analysis under the header "pre-match comparisons" the sample includes all IPOs. See Table 1 for details on IPO sample construction. For analysis under the header "post match comparison" the sample includes IPOs emerging from propensity score matching analysis. We use the probit model of primary share increases (Model (1) of Table 4) to identify best matches for each IPO increasing primary shares. We use one-to-one matching with replacement where propensity scores must be within 1%. We drop IPOs increasing primary shares without viable matches and those for which there is no "common support" (i.e., we drop IPOs where the propensity score for the firm increasing primary shares is greater than the maximum or less than the minimum of all IPOs not increasing primary shares).

	Pre-Match Comparison				Post-Match Comparison			
	Primary Share Not Increase Mean	Primary Share Increase Mean	Diff	p-value	Primary Share Not Increase mean	Primary Share Increase mean	Diff	p-value
Market Conditions								
Nasdaq Composite Return 30 days pre first pricing	5.509	6.125	0.616	0.142	5.674	6.073	0.399	0.594
Fama-French 48 Industry Return 30 Days Pre-First Pricing	1.783	2.056	0.273	0.177	1.997	2.035	0.038	0.906
Nasdaq Composite Return first pricing to offering	0.484	0.689	0.205	0.173	0.919	0.678	-0.240	0.296
Fama-French 48 Industry Return first pricing to offering	0.403	0.551	0.148	0.345	0.595	0.552	-0.043	0.857
Log of IPO Capital Raised LTM at First Pricing	10.247	10.284	0.038	0.048	10.255	10.284	0.029	0.326
Issuer/Issue Characteristics								
Log of Filing Size	4.962	4.774	-0.188	0.000	4.785	4.779	-0.005	0.941
Log of LTM Revenues	4.498	3.486	-1.012	0.000	3.464	3.530	0.065	0.737
Log of Firm Age	2.576	2.446	-0.130	0.001	2.434	2.453	0.020	0.736
Log of Firm Assets	5.150	4.578	-0.572	0.000	4.635	4.601	-0.034	0.839
Log of Long-Term Debt	2.884	2.495	-0.389	0.001	2.573	2.530	-0.043	0.827
Private Equity Backed Dummy	0.318	0.239	-0.078	0.000	0.275	0.243	-0.032	0.319
Venture Capital Backed Dummy	0.458	0.535	0.077	0.001	0.463	0.531	0.068	0.164
Overhang based on filing terms	3.726	3.647	-0.080	0.489	3.613	3.636	0.023	0.898
Underwriter Reputation								
Lead-Left LTM Market Share	7.931	7.043	-0.888	0.000	7.062	7.042	-0.020	0.958
Lead-Left Carter Manaster Rank	8.147	8.044	-0.104	0.132	8.003	8.037	0.034	0.781
Price and Share Adjustments								
Price Adjustment if Negative	-9.296	-9.930	-0.634	0.335	-9.707	-10.079	-0.372	0.699
Price Adjustment if Positive	5.276	7.084	1.808	0.000	6.089	6.733	0.644	0.595
Observations	1222	824			804	804		