Key Investors in IPOs*

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Abstract

We statistically identify institutional investors who persistently report holdings of the most underpriced US IPOs. As a group, these key investors' holdings are strongly related to IPO underpricing and offer price revisions, more so than any other variables. Key investors appear to be better informed than other institutional investors. Key investors' post-IPO trades predict future returns and their participation is more strongly related to underpricing when they specialize in the IPO firm's industry. We find no direct evidence that key investors' participation is motivated by underwriters' earning kickbacks. However, a significant fraction of the economic benefits of underpricing accrues to non-key investors, allowing for agency-based explanations for underpricing.

JEL Classifications: G23, G24, G32

Keywords: IPO Underpricing, Institutional Investors, Underwriters

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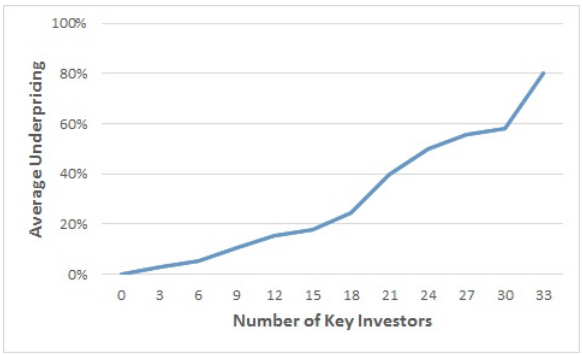
Introduction

In recent decades and across the globe, underpricing of initial public offerings (IPOs) has been established as a robust empirical phenomenon, averaging upwards of 15% (Ritter and Welch, 2002; Loughran and Ritter, 2002; Ljungqvist, 2007; Loughran, Ritter and Rydqvist, 1994). The significance, persistence and wide-spread nature of these first-day price increases have puzzled researchers and spawned a large theoretical and empirical literature. Among the many proposed theories, many focus on underpricing as a means to compensate specific investors for one reason or another. For example, some investors may receive more underpriced shares due to informational advantages (Rock, 1986; Benveniste and Spindt, 1989; Sherman and Titman, 2002), their abilities to add value to firms (Stoughton and Zechner, 1998), or favoritism by investment banks (Aggarwal, Krigman and Womack, 2002; Loughran and Ritter, 2004; Hao, 2007). Interestingly, many different theories have, at least to some extent, received empirical support.[1]

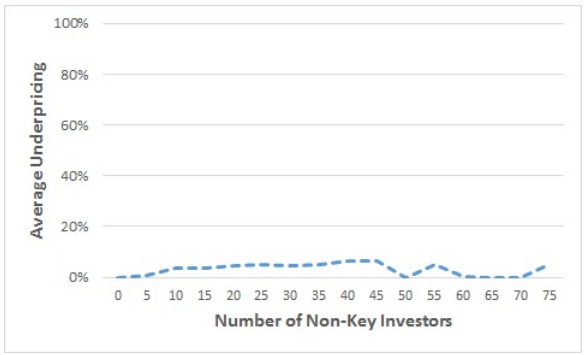
Such a diversity of theories with supporting evidence makes clear that a number of factors contribute to underpricing. However, the primary driver, or drivers, of underpricing remain equally unclear. This ambiguity relates, at least in part, to time-series and cross-sectional data limitations. For examples, studies have documented evidence of favoritism in IPOs primarily during the tech bubble (Reuter, 2006; Ritter and Zhang, 2007), and evidence that allocations reward information has originated from small, proprietary data sets (Cornelli and Goldreich, 2001; Aggarwal, Prabhala and Puri, 2002). Given that many studies find that some investors tend to be favored in IPOs, it is surprising that no existing studies try to identify investors that are persistently favored, i.e. associated with abnormally-underpriced IPOs. Our paper fills this gap. Rather than starting with a specific sample and analyzing investors' returns, we analyze a broad sample using returns to identify which investors are most associated with underpricing. By analyzing individual institutional investors across IPOs and time, we provide evidence consistent with investors' information being a primary driver of underpricing.

We first develop a methodology that identifies a group of investors, termed key investors, that are associated with the most underpriced IPOs. Using institutional investors' 13F filings to proxy for IPO participation, we identify investors who are associated with statistically-significant abnormal underpricing over the prior year. On average, we classify 11% of institutional investors as key investors. Those key investors continue to be associated with

[1]Ritter and Welch (2002), Ljungqvist (2007) and Ritter (2011) review the empirical and theoretical underpricing literature.



(a) Key Investors



(b) Non-Key Investors

Figure 1: Key investors' participation is positively related to underpricing.

abnormal underpricing in the future: 38% of key investors in a given year are classified as key investors in the following year. Furthermore, the measure is persistent for 10 years, suggesting that key investors have traits leading to frequent and repeated participation in highly-underpriced IPOs.[2]

Figure 1(a) shows our main finding: the number of key investors participating in an IPO is positively related to underpricing. In univariate regressions, key investors' participation explains 42% of the variation in underpricing, more than any other variable. For comparison, offer price revision, the percentage change in price from the initial prospectus to the final offering, explains 37% of underpricing variation. Ex ante, the predicted relation between key investors' participation and underpricing is ambiguous; key investors may simply be attracted to firm characteristics, such as being high-tech or VC-backed, which are associated with high underpricing. We control for this and other possibilities by including common explanatory variables from the IPO literature. Including standard variables to control for alternative explanations, a one-standard-deviation increase in key investors' participation increases underpricing 15% (from the average underpricing of 21% to 36%). In contrast, Figure 1(b) shows non-key institutional investors' participation is not related to underpricing. These results establish key investors' importance to the cross-sectional variation of underpricing.

We use additional tests to distinguish among alternative explanations for the relation between key investors' participation and underpricing, finding support for information-based theories. First, we find that the relation is non-linear, which is also suggested by the con-

[2]Our results are robust to alternative methods of specifying statistical significance, such as: (i) means or medians; (ii) p-value thresholds of 1% or 5%; and (iii) an alternative measure using money left on the table (see Section 5.2 for details).

vex shape of Figure 1(a). This is consistent with underwriters' using extreme underpricing to compensate key investors for information. Second, we show a strong positive relation between key investors' participation and offer price revisions, consistent with offer prices' responding to key investors' information. Third, key investors' trades of IPO firms in subsequent quarters predict the following quarters' abnormal returns, while other investors' trades do not, consistent with key investors' being better informed. Finally, our underpricing results are stronger for harder-to-value firms, where information from investors is likely more valuable, and when key investors specialize in the IPO firm's industry and are more likely informed. Collectively, these results provide positive support that key investors' information is a primary determinant of underpricing.

Several other tests indirectly support information-based theories by casting doubt on alternative explanations. For example, underwriters' desires to generate kickbacks may lead to key investors receiving abnormally underpriced shares. However, kickback-based theories suggest that the number of shares allocated to key investors, not the number of key investors' participating, should relate to underpricing. In a horse-race between the two, only the number of key investors' participating is significantly related to underpricing, supporting the information-based theories. It is also possible that large funds' bargaining powers or underwriter-fund relationships drive our main findings. However, neither key investors from large funds nor key investors with underwriter relationships exhibit stronger ties to underpricing, making it is less likely that bargaining power or underwriters' favoritism are driving our results. An instrumental variables analysis provides similar conclusions by showing that key funds' industry specializations, and not their relationships with underwriters, are related to underpricing through their reported holdings.

Because we rely on holdings data, our results could be due to either key investors' receiving allocations in IPOs or post-IPO buying. While 13F holdings have been used to proxy for allocations in prior studies (Reuter, 2006; Binay, Gatchev and Pirinsky, 2007), we conduct three tests to further justify their use. First, we analyze allocations data from 6 IPOs used in Ritter and Zhang (2007). Reported holdings and actual allocations are 87% correlated for key investors and 79% correlated overall, suggesting that 13F holdings reflect meaningful variation in actual allocations. Second, we analyze IPO timing, finding key investors' holdings do not systematically differ from other investors' holdings based on when an IPO occurs within a quarter. If post-IPO buying were driving key investors' holdings, it is likely that IPOs occuring earlier in the quarter would have relatively more key investor participation. The lack of any difference suggests that post-IPO buying is not biasing our measure. Third,

we consider post-IPO buying as a trading strategy, which we show is not profitable, suggesting little motive for key investors to systematically initiate positions after significantly underpriced IPOs. While these tests are consistent with 13F holdings' reflecting allocations, that is not a necessary condition for key investors to impact IPO pricing. For example, participating in road shows or attempting to buy shares in IPOs conveys information to underwriters.

Aggregate participation statistics leave room for many alternative explanations for IPO underpricing. Key investors, who make up 11% of investors and account for the majority of the relation between investor participation and underpricing, only account for 24% of reported holdings and 34% of the inferred money left on the table in IPOs. Put differently, underpricing could be cut by almost two-thirds while still providing the same economic value to key investors. While the underpricing benefits going to non-key investors may add value to firms, it is also possible that agency-based motivations keep underpricing higher than is necessary to secure key investors' participation.

Our paper makes a number of contributions to the IPO literature. First, we develop an alternative methodology to analyze underpricing, focusing on a group of investors who have received significant underpricing in past IPOs. Prior studies tend to relate underpricing to different groups of investors. As examples, Hanley and Wilhelm (1995) and Aggarwal, Prabhala and Puri (2002) analyze differences between retail and institutional investors, while Reuter (2006) and Ritter and Zhang (2007) study funds with close ties to underwriters. While these studies provide insights into various channels' contributing to underpricing, using reported holdings allows us to leverage a larger sample and study the most economically significant drivers of underpricing.

Using this methodology, we show the importance of key investors to underpricing and offer price revisions. Aggarwal, Prabhala and Puri (2002), Field and Lowry (2009) and Chemmanur, Hu and Huang (2010) all provide evidence of institutional investors' importance to the IPO process. Our study extends their findings by showing that key investors, who appear informed and persistently participate in the most underpriced IPOs, comprise the group of institutional investors that matters most to IPO pricing. Sibo (2014) also studies the persistence of institutional investors' performance using Chinese IPOs, finding that institutional investors that performed well in the past tend to perform well in the future. Liu et al. (2015) relates investors' attention, e.g. attending a road show and forming an opinion, to IPO underpricing. Our findings are consistent with key investors' attention being sought out by underwriters.

The rest of the paper is organized as follows. Section 1 describes the data and Section 2 describes how we identify key investors. We present our main results in Section 3. Section 4 discusses possible alternative explanations, while Section 5 highlights several robustness tests. Section 6 concludes.

1 Data and Sample

We identify IPOs using the Thomson Securities Data Corporation (SDC) Platinum Global New Issues database. The sample includes IPOs of U.S. firms' common stocks completed between 1985 and 2011. As is common in the literature we exclude unit offerings, spinoffs, real estate investment trusts, rights issues, closed-end funds and trusts, and IPOs with an offer price less than five dollars. To be included in the sample, we require that a firm be in the Center for Research in Security Prices (CRSP) database and that at least one institution reports owning shares in the first quarter after the IPO. Holdings data are from Thomson-Reuters 13F Institutional Holdings database. We supplement data from the SDC, CRSP and 13F databases from several sources. Consumer Price Index (CPI) data from the Bureau of Labor Statistics is used to adjust dollar values to year 2000 dollars. Founding dates, monthly underpricing and issuance activity, and underwriter rankings are taken from Jay Ritter's website.[3] The resulting sample includes 4,928 IPOs.

Lacking direct data on participation of investors in IPOs, we follow Binay, Gatchev and Pirinsky (2007) and Reuter (2006) and proxy for participation using the first reported institutional holdings data after issuance. While using 13F holdings data to proxy for investors' participation in IPOs has several shortcomings (limited and delayed reporting), several studies provide evidence that this proxy is highly correlated with actual IPO allocations. Using proprietary data on a sample of 38 IPOs managed by a single underwriter, Hanley and Wilhelm (1995) finds that the correlation between 13F holdings data and actual allocations is 0.91. Using six of the IPOs with known allocations featured in Ritter and Zhang (2007), we find that 51% of funds holding shares at the end of the quarter received allocations. For key investors (defined shortly), 58% of holdings are associated with IPO allocations. In Section 4.1, we perform further tests to justify 13F reports as a proxy for investors' participation in IPOs.

Our proxy for participation helps to overcome one limitation in the IPO literature, but allows for alternative interpretations of our results. The limitation, which is common in the

[3]The data are available at https://site.warrington.ufl.edu/ritter/ipo-data/

literature, is due to a lack of data on allocations in IPOs.[4] While 13F data noisily identifies investors that were interested and participated in IPOs, the holdings originating from post-IPO buying may be a significant factor. In fact, a priori, the role of investors buying shares after the IPO may be as important for determining the offer price as the role of investors participating in the offering. While we attempt to distinguish whether 13F holdings are more driven by allocations or post-IPO buying, we acknowledge that our measure cannot definitively separate the two.

2 Defining Key Investors

Key investors are those that are likely to influence price setting and allocations in IPOs. If such a group of investors exists, and has traits of particular value to firms or underwriters, it is likely that those investors will continue to influence pricing in future offerings. Therefore, we hypothesize that investors who have experienced abnormal underpricing in past offerings are likely to predict underpricing in future IPOs.

To determine those funds that have received abnormal underpricing, we begin by constructing, on a quarterly basis, a measure reflecting the average adjusted underpricing of the funds' recently reported holdings. For each quarter, we consider IPOs over the past 12 months, excluding any funds that did not report holdings in at least 4 IPOs. For each IPO, we adjust realized underpricing by subtracting the month's average underpricing:

$$AdjUnderpricing_i = Underpricing_i - \frac{\sum_{j=1}^{J(i)} Underpricing_j}{J(i)} \tag{1}$$

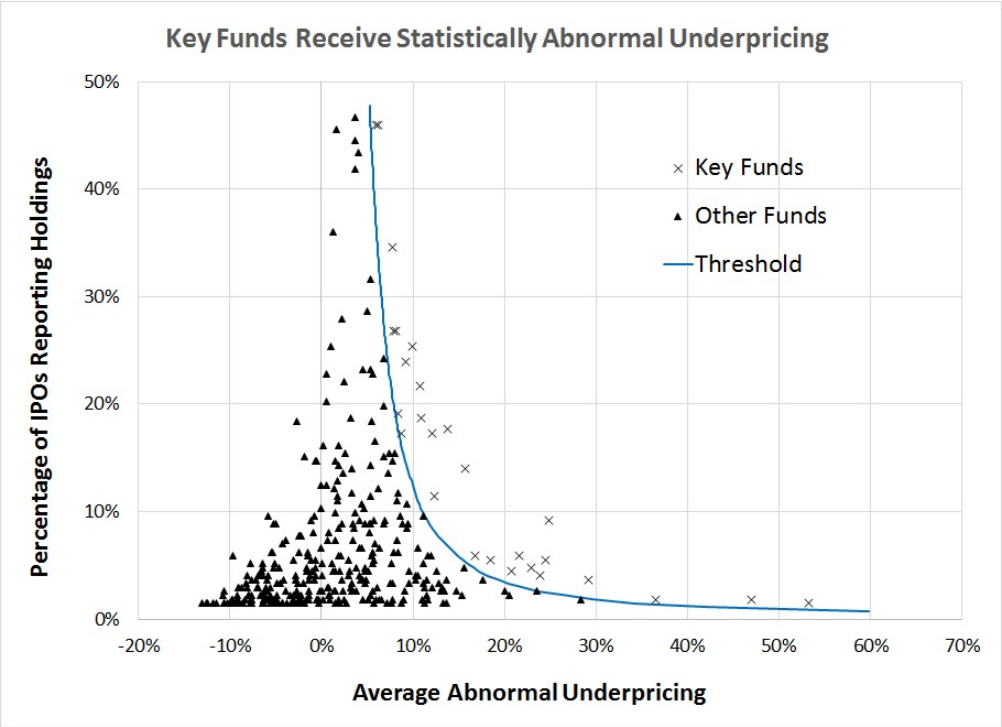
where $J(i)$ is the set of IPOs completed in the same month as IPO i. A fund's average adjusted underpricing is the average of the adjusted underpricing for the IPOs, over the last 12 months, for which the fund reported holdings:

$$AvgAdjUnderpricing_k = \frac{\sum_i^I AdjUnderpricing_i \times \mathbb{1}_{i,k}}{\sum_i^I \mathbb{1}_{i,k}} \tag{2}$$

where k indexes funds and $\mathbb{1}_{i,k}$ equals 1 if fund k reported holding shares in IPO i and I is the set of IPOs over the past year.

[4] Jenkinson and Jones (2004) and Cornelli and Goldreich (2001) overcome this limitation by using detailed, proprietary underwriters' data about bids and allocations. In both cases, the data are from a single underwriter. However, the papers find mixed results, possibly due to differences between the underwriters that supplied the data.

Figure 2: Scatter-plot of key funds and other funds in 1994, as an example. The solid line represents the threshold at which we are 99% confident (generated from 100,000 random sample portfolios) that the average adjusted underpricing is significantly different from zero.



We rely on statistical methods to determine which funds received abnormal underpricing. For each quarter, and for each possible number of IPOs received by a fund, we bootstrap distributions of average adjusted underpricing. For example, to benchmark a fund that received 10 IPOs in 2005, we would sample, with replacement, 10 IPOs from those that occurred in 2005. We then calculate average adjusted underpricing for that random sample. We repeat this process 100,000 times for each date and for each number of potential IPOs received over the prior 12 months. Finally, we compare each realized value of average abnormal underpricing to the fund's corresponding distribution of randomly generated values. We define key investors ($KeyInvestor = 1$) as the funds having realized values greater than at least 99,000 of the random draws, equivalent to a statistical threshold of 1% (p-value of 0.01). 11% of fund-year observations meet the 1% threshold.

Figure 2 shows realized values at the start of 1994. The x-axis displays average abnormal underpricing, while the y-axis displays the percentage of the IPOs the fund reported holding. Note that even negative abnormal underpricing of -10% on the figure can still imply positive average underpricing for a fund once one adds the mean monthly underpricing of 14% for

1994. The solid line represents the bootstrapped threshold, while the X's, which lie to the right of the threshold, represent key investors. Those investors have average abnormal underpricing which is statistically greater than zero at the 1% confidence level. The triangles represent other investors, and all lie to the left of the threshold.

Our main variable of interest, *NumKeyInvestors*, measures key investors' participation in IPOs. For each IPO, we count the number of key investors who hold the firm's stock at the end of the first quarter following the IPO.

$$NumKeyInvestors = \sum_{k \in K} KeyInvestor_k \tag{3}$$

where K is the set of investors who hold shares at the end of the first quarter following the IPO.[5] The first row of Table 1 shows that our key investor measure is persistent. 38% of key investors at the beginning of one year are classified as key investors at the beginning of the following year. This is a significant portion as random assignment would suggest only 11% overlap. Furthermore, this persistence continues for 10 years. In each subsequent year, the excess proportion (relative to random assignment) of original key investors classified as key investors remains significant. The next three rows show that alternative measures of key investors (using either a 5% threshold, medians rather than means, or both) show persistence as well. The fifth and sixth columns show that using money left on the table ($Shares \times OfferPrice \times Underpricing$) in place of underpricing yields similar results. We discuss alternative measures in Section 5.2 and supplemental results are provided in the Online Appendix. Finally, the last two rows show the persistence of the top and bottom 10% of funds. Rather than focusing on a set statistical threshold, this measure ensures 10% of funds are classified as key investors each period. For the top 10%, the measure is persistent, although persistence is weaker. For the bottom 10%, there is weak persistence in the first year, which becomes insignificant in subsequent years. A lack of stable persistence for the worst funds suggests we are not simply identifying a statistical artifact.

Table 2 shows summary statistics of key and non-key investors. Key investors are larger and older than non-key investors, and more actively churn their portfolios. Key investors and non-key investors tend to hold IPOs similar lengths of time . While hedge funds are slightly under-represented in the key investor population, the difference is not significant.[6]

[5] Aggregating the number of shares held by key investors is a reasonable alternative measure. However, our results (discussed shortly) show that the number of key investors, and not the total number of shares they hold, is positively related to underpricing.

[6] We use the hedge fund classifications introduced in Agarwal, Fos and Jiang (2013) and Agarwal et al. (2013).

Table 3 summarizes the most common key investors, showing that a broad range of fund types and sizes are represented. For example, Essex Investment Management Company, a hedge fund and the most frequent key investor, manages a little over $1 billion in assets, while Fidelity is ranked second and manages over $400 billion.[7] In general, the funds represented are heterogeneous, including the largest and most prominent funds and banks, as well as insurance companies and many smaller and lesser-known funds.

3 Main Results

3.1 Underpricing

While it was not ex ante clear whether some investors will be persistently related to underpricing, the prior section establishes the existence of key investors in IPOs. Given the persistence of key investors, it is not surprising that key investors' participation is positively related to underpricing. However, what is surprising is the economic and statistical significance of that relation. Column (1) of Table 4 shows that key investors' participation explains 42% of the variation in underpricing, more than any other control variable in univariate regressions. For comparison, the second-most significant variable is offer price revision, which explains 37% of the variation. Economically, a one-standard-deviation increase in key investors' participation (about 9 key investors) is associated with a 26% increase in underpricing (from the average underpricing of 21% to 47%).

To examine why key investors' participation is so strongly related to IPO underpricing, we begin by including common control variables from the IPO literature in our regressions. Column (2) provides a baseline result using only control variables and year fixed effects. Including controls allows us to test whether key investors are simply attracted to offer characteristics (e.g. firm size, VC-backed, primary versus secondary shares sold, etc.) that are associated with high underpricing. If this were the case, including controls would remove the significance between key investors' participation and underpricing. However, Column (3) shows that this is not the case. Even in the presence of controls, key investors' participation is most significantly related to underpricing, and the economic magnitude of the effect remains strong (a one-standard-deviation increase in key investors' participation is associated with a 15% increase in underpricing to 36%).[8]

[7] Dollar figures are based on reported 13F holdings.

[8] Our primary result is robust to separate analysis of the periods 1985 - 1997, 1998 - 2000 and 2001 - 2011. Alternatively, using the ratio of the number of key investors to the number of total investors gives

Including controls for several outcome variables, as well as firm and offer characteristics, allows us to cast doubt on several potential explanations for key investors' relation to underpricing. Both Booth and Chua (1996) and Ellul and Pagano (2006) link underpricing to secondary-market liquidity. Consistent with the argument in Ellul and Pagano (2006) that anticipating an illiquid post-IPO market investors may require a significant discount (underpricing), we find a positive relation between underpricing and post-IPO spreads (using the bid-ask spread measure from Corwin and Schultz (2012)). However, this relation does not remove the explanatory power of key investors' participation, suggesting that key investors affect IPO pricing directly and beyond their possible effect on post-IPO liquidity of the stock. Loughran and Ritter (2004) propose that firms accept underpricing in exchange for analyst coverage. Our results may be explained by key investors' being favored by underwriters in offerings where analyst coverage is particularly desirable. We control for this possibility by counting the number of analysts covering firms at the end of their quite-periods and one year after their IPOs. Similar to the liquidity measure, including measures of analyst coverage does not remove the explanatory power of key investors' participation.

Other potential explanations for our main finding are that key investors are better-informed investors or are investors who add value to firms. Both of these explanations have rich theoretical backgrounds. Beginning with Rock (1986) and Benveniste and Spindt (1989), many models have linked information asymmetry to underpricing. Similarly, many models have linked various value-adding activities to underpricing. For examples, Mello and Parsons (1998) and Stoughton and Zechner (1998) propose investors add value through monitoring, Holmstrom and Tirole (1993) and Brown (2015) consider investors' impacts on firm value by increasing price informativeness, and Banerjee, Hansen and Hrnjić (2009) focuses on investors' long-term holding. All of these theories commonly predict that key investors' participation in IPOs is positively correlated with underpricing, and importantly, most of the value-add theories rely on investors' being informed to some degree. As a result, most of our tests are not able to distinguish explicitly among the information and value-add theories. To simplify exposition going forward, we refer to tests of these many hypotheses as tests of information theories.

To separate information theories from alternative explanations, we focus on the book-building model of Sherman and Titman (2002). In their model, an underwriter compensates investors for costly information production by underpricing shares. To maximize mechanism efficiency, the underwriter concentrates underpricing in offerings where virtually all investors

qualitatively similar results.

report good information. This results in a highly skewed distribution of underpricing, "with a few hot issues having enormous price jumps."[9] If key investors are better-informed, information theories suggest a non-linear relation between key investor' participation and underpricing, with extreme underpricing occurring when large numbers of key investors report holding shares. Given these observations, we expect that $NumKeyInvestors^2$ will be positively related to underpricing. Column (4) shows that the coefficient on $NumKeyInvestors^2$ is significantly positive, confirming the non-linear relation between key investors' participation and underpricing. Figure 1(a) is consistent with this finding, showing a convex shape and average underpricing over 80% for IPOs with the most key investor participation. While the non-linear relation does not rule out other theories (although we know of no other theories predicting a non-linear relation), it provides strong initial support for key investors' being informed.

A large portion of the IPO literature focuses on underwriters' abilities to profit indirectly from underpricing. The general idea is that investors pay underwriters a portion of their underpricing profits through other lines of business, e.g. trading commissions (Loughran and Ritter, 2004). Underwriters could then maximize their total revenues by allocating more shares to investors that generate these kickbacks. Therefore, if key investors' participation is driven by a desire to maximize kickbacks, we expect that the percentage of shares key investors hold, not the number of key investors, should be strongly related to underpricing. While Column (5) shows that, in the absence of $NumKeyInvestors$, the percentage of shares held by key investors is positively related to underpricing, Column (6) shows that when included together, only the coefficient on $NumKeyInvestors$ remains positive.[10] This horse-race between the number of key investors and the percentage of shares they hold casts doubt on hypotheses in which key investors' participation is driven by underwriters' seeking kickbacks. Furthermore, this finding is particularly negative for kickback-based theories if underwriters must enforce payment of kickbacks, as they would likely employ relatively few investors to maximize efficiency and to avoid unnecessary publicity that might arise if numerous investors are involved.

Overall, the evidence suggests that the relation between key investors and underpricing is likely due to information or other value-creating activity of key investors. While still possibilities, our evidence casts doubt on post-IPO liquidity, analyst coverage and underwriter kickbacks as explanations for key investors' participation in IPOs, particularly due to the

[9]Sherman and Titman (2002) pg. 16. Liu et al. (2015) generates similar predictions.

[10]Using the total number of shares held by key investors, rather than the percentage, gives similar results.

non-linear relation between their participation and underpricing.

3.2 Industry Specialization and Hard-to-Value Firms

If funds are providing information in the IPO pricing process, it seems likely that they do so in industries in which they specialize.[11] Therefore, if information is driving the relation between key investors' participation and underpricing, then this relation is likely stronger when those key investors are more specialized in the IPO firm's industry. To test this hypothesis, we construct a measure of fund specialization based on reported 13F holdings. In each quarter, funds' reported holdings are divided into Fama-French 48 industries and industry weights are calculated for each fund.[12] Each fund's industry weights are then standardized by subtracting the mean weight and dividing by the standard deviation of weights for all funds reporting holdings in that quarter. The resulting variable, $IndOverWt_{I,t}$, will be positive for funds' having relatively large holdings in industry I.

To relate industry over-weightings to underpricing, we create a measure that indicates to what extent the funds reporting holdings in firm i are investing in the industry that firm i belongs to. Using We calculate the average value across funds

$$InvSpecialization = \frac{\sum IndOverWt_{I(i,t(i))}}{NumInstInvestors} \tag{4}$$

where $I(i)$ is the industry of firm i and $t(i)$ is the quarter of the IPO. For each IPO, we use $IndOverWt_{I,t}$ based on the holdings reported prior to the IPO. $KeyInvSpecialization$ and $NonKeyInvSpecialization$ are calculated similarly using only key investors' and non-key investors' industry specialization measures. Table 5 displays results consistent with key investors' specializations relating to underpricing. Column (1) shows that underpricing is higher when all investors' average industry specialization is higher. Columns (2), (3) and (4) show the relation is stronger for key investors than non-key investors, and Columns (5) and (6) use interaction terms to show industry specialization matters more when more investors participate. The relation is strongest for key investors, whereas for non-key investors there is no relation between their industry specialization and underpricing. These findings are consistent with key investors' industry expertise and information being important to IPO pricing.

[11] Kacperczyk, Sialm and Zheng (2005) shows that funds concentrate their holdings in industries in which they have informational advantages.

[12] Classification data are available at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/.

If key investors are providing valuable information, it is likely that this information is more valuable in some IPOs than others. If this is the case, key investors' presence should matter relatively more in IPOs with more uncertain valuations. In general, growth options are more difficult to value than assets-in-place, so we measure firms based on the percentage of their value attributable to growth options. We predict that the relation between key investors' participation and underpricing will be stronger for those firms whose values are more predominantly driven by growth option value. We follow Benveniste et al. (2003) in using the present value of growth options, $PVGO$, as a measure of valuation uncertainty.

$$PVGO = \frac{E[P] - EPS/R}{E[P]} \tag{5}$$

where $E[P]$ is the midpoint of the offer price filing range and EPS/R is the present value of the issuing firm's current earnings at the time of the IPO discounted at the industry cost of capital. The lower the value of $PVGO$, the less speculative the offering. In our sample, the mean(median) $PVGO$ is 0.75(0.93), so 75% of the average company's offer price reflects future growth-option value.

We test whether key investors are more important for pricing in hard-to-value IPOs by interacting key investors' participation with $PVGO$ and a dummy variable indicating whether the firm had positive earnings prior to the IPO (which is consistent with lower growth-option value). We expect the interaction to be positive for $PVGO$ and negative for $PosEarningsDummy$. Columns (7) and (8) in Table 5 display the results. As predicted, firms' having more of their value in growth options display a stronger relation between key investors' participation and underpricing. Firms' with positive earnings display a weaker relation between key investors' participation and underpricing. Harder-to-value firms with zero or negative earnings are associated with higher underpricing compared with easier-to-value firms with positive earnings. This evidence is again consistent with key investors' bringing information to the IPO process.

3.3 Offer Price Revisions

Offer price revisions allow us to further distinguish information theories from alternatives based on kickbacks. Were underpricing entirely motivated by underwriters' earning kickbacks, it is likely that key investors would experience less positive or even negative revisions as underwriters set offer prices lower to transfer more rents to those investors (and subsequently recapture those rents through other lines of business). While that broadly applies

to kickback-related explanations, it is important to note that laddering (price support) can generate the opposite prediction. As shown by Hao (2007), laddering should be associated with positive offer price revisions and positive underpricing when underwriters do not receive kickbacks from investors. However, profit-sharing via kickbacks can motivate underwriters to lower offer prices as in some agency-based explanations. Therefore, we expect that non-kickback-based motivations for underpricing lead to a positive relation between key investors and offer price revisions.

Table 6 shows that $NumKeyInvestors$ is positively related to offer price revisions. By itself, Column (1) shows that $NumKeyInvestors$ explains 31% of variation in offer price revisions. Column (2) provides a baseline specification with controls, and Column (3) shows that $NumKeyInvestors$ maintains as an important explanatory variable in the presence of controls. Overall, our results for offer price revisions are consistent with value-creating theories for key investors' post-IPO holdings.[13]

While our findings are inconsistent with purely kickback-motivated underpricing, our results are consistent with a setting in which key investors are not incrementally informed relative to other investors, but benefit from preferential treatment. For example, if investors all provide information, and the quality of that information cannot be measured by their participation alone, then it is possible that underwriters use that orthogonal information to benefit preferred investors (and themselves via kickbacks). In the example, preferred investors would receive more allocations in offerings with large price revisions and large underpricing, without providing information commiserate with those benefits. While our prior test cannot rule out this explanation, it is important to note that this explanation relies on information to provide the initial basis for underpricing – kickbacks simply provide an explanation of why some investors perform better than others. To examine which investors are likely to be the source of information in IPOs, our next section tests whether key investors are better informed than other investors.

3.4 Post-IPO Abnormal Returns

Many information theories rely on key investors being informed prior to the IPO and being rewarded for revealing their information during book-building. If key investors have valuable information at the IPO, then they may continue to possess or generate information after the

[13]Bubna and Prabhala (2011) and Ljungqvist and Wilhelm (2002) also provide evidence consistent with investors' receiving rewards for information revelation during book-building, while Chiang, Qian and Sherman (2010) show sophisticated investors earn better returns in auctioned IPOs.

IPO. If this is the case, then their trading activity after the IPO may predict future returns. As such, finding a positive relation between future abnormal returns and trading would be consistent with information theories. A positive relation is also predicted by theories in which investors add value to the firm. Whatever the value-proposition, key investors' selling would be associated with the loss of value and possibly negative future returns.[14] While we cannot distinguish the information and value theories, other hypotheses do not predict abnormal returns following funds' trades.

To test for informed trading, we regress quarterly returns on investors' net trading in the prior quarter. Specifically, we measure the change in the number of initial investors (key and otherwise) who own the stock at the end of the quarter.[15] As the group of initial investors who received allocations does not change, the change in investors will be non-positive. Therefore, we expect that those firms who are sold by the most investors in the prior quarter will have worse abnormal returns going forward. Furthermore, we expect key investors' selling to be incrementally informative, so more sales by key investors are likely to lead to worse returns. We measure abnormal returns using cumulative abnormal returns (CARs) and buy-and-hold abnormal returns (BHARs) using both a market-model and a four-factor model for risk-adjustment. Table 7 presents the results.

Panels A and B of Table 7 shows CARs and BHARs using the four-factor model for risk-adjustment.[16] The results are generally consistent in the panels, so we focus on the results in Panel A. Column (1) shows that overall institutional selling is predictive of future abnormal returns, although the economic significance is small. For each investor who sells, the following quarter's return falls by 10 bps. Column (2) shows that the effect is concentrated with key investors, where per-investor-selling lowers quarterly returns by 70 bps. When key investors' selling is taken into account, other investors' selling is no longer predictive of returns.

If industry specialization facilitates information acquisition, we would expect better return predictability for funds that specialize in the IPO firm's industry. To test this hypothesis, we define specialist key investors as key investors with $IndOverWt_{I,t} > 0$, meaning they overweight the IPO firm's industry relative to the 13F-reporting population. $KeyInvestorSpecialists$ gives the total number of specialist key investors reporting holdings in an offering. Column (3) shows that return predictability is mainly from specialist

[14]The timing of the negative returns depends on when markets learn about value-adding investors' selling or learn the information motivating their selling.

[15]Sias, Starks and Titman (2006) shows that the change in number of institutions holding a stock are more related to contemporaneous returns than changes in the fraction of shares held by those institutions.

[16]Results using a market model are qualitatively similar.

key investors, as their sales are associated with 110 bps lower returns.

The predictability of key investors' trades is suggestive of these investors' being informed. If key investors do have better information about the IPO firm, the strong relation to underpricing could be due to either allocations or post-IPO buying. In the case of allocations, underwriters may be using that information to price the offerings. For post-IPO buying, investors may be buying the IPOs that were underpriced and are expected to continue to outperform. If the later explanation is most relevant, we would expect to see that key investors' participation is positively related to first-quarter returns. To test this hypothesis, we consider a trading strategy that buys on the first-day of an IPO (at the close) and holds until the end of the quarter. If this is profitable, then key investors may simply be those who engage in this post-IPO, buy-and-hold strategy. Column (1) of Table 8 shows that such a strategy is not generally profitable. Column (2) shows that conditioning on underpricing does not improve the strategy's profitability. Moreover, Column (3) shows returns are not higher when more investors participate. However, if key investors have more information a holdings primarily reflect post-IPO buying, they may be skilled at identifying the best stocks to buy after the IPO. Column (4) suggests this is not the case. First-quarter returns do not depend on the number of key investors participating. While not conclusive, this test suggests that the relation between key investors and both underpricing and offer price revisions is due to their information affecting IPO pricing.

4 Alternative Explanations

We analyze several alternative explanations for our findings. While we cannot rule out alternative explanations, a lack of support for alternatives indirectly supports our main results.

4.1 Post-IPO Buying: 13F Holdings as a Proxy for Allocations

We do not observe directly the participation of investors in an IPO. Instead, we use the reported share holdings by investors in the quarter when the IPO took place as a proxy for investors participation. The delay between the date of the IPO and the reporting date allows for the possibility that investors do not receive allocations of shares in the IPO, but rather buy shares after the company is listed in the secondary market.

For post-IPO buying to be the primary driver of reported holdings, one needs to argue that for some reason, some investors do not try to buy shares in the IPO, but do so after the

shares are traded, despite substantial underpricing. One rationale for such behavior would be the anonymity of secondary market purchases compared with direct participation in the IPO. For example, some of the underwriter's competitors and funds affiliated with them may prefer not to reveal positive information during book-building, thus forcing the underwriter to set a low price and upset the issuing firm. Presumably, these key investors may still be informed about the firm's value to have the confidence to buy in the volatile early market. Alternatively, key investors may simply follow a behavioral strategy of buying shares that experience significant underpricing. As our earlier test shows, such a strategy does not generate abnormal returns. The funds that we identify as key investors listed in Table 3 include many well-established and reputable institutions that, in our view, are unlikely to follow this behavioral strategy.

In an attempt to distinguish whether allocations or post-IPO buying is more likely driving our results, we conduct several tests of the 13F holdings data. The tests are generally consistent with holdings' representing allocations, although we cannot rule out that our results may be driven by post-IPO buying. We begin by comparing a limited sample of actual allocations to 13F holdings.

Ritter and Zhang (2007) analyze allocations data from 11 IPOs acquired through a Freedom of Information Act request.[17] Using the overlap between their allocations data and our sample, we compare 6 IPOs' actual allocations to reported 13F holdings at the end of the quarter. Table 9 provides summary statistics. Many allocations were made to individuals or foreign holders who do not report in 13F holdings. Despite this, 48% (64%) of the allocations (shares) match to funds that report in the 13F holdings data. However, only 19% (9.3% of all allocations) of those matches were also reported as holdings in the 13F data. The other 81% had apparently sold their shares by the end of the quarter. Selling is particularly prominent for new investors (who did not report holdings of 4 IPOs in the last year): key investors retain 43% of their allocations, non-key investors retain 15%, and new investors retain only 2%.

Some funds buy after the IPO and do not receive allocations. In the 6 IPOs, 48% of key investor allocations are added after the IPO, while 49% of total allocations are added after the IPO. For new investors, the vast majority (78%) are added after the IPO. While based on a small sample, this data suggests that we underestimate the number of each type of investor. Combining the measurement errors due to selling and secondary-marketing buying, 13F holdings data underestimates the number of key investors by 17%, the number

[17]The data are available at https://site.warrington.ufl.edu/ritter/ipo-data/.

of non-key investors by 72% and the number of new investors by 93%.

While post-IPO buying and selling add variation to 13F holdings, for holdings to be a valuable proxy for allocations we only need variation in holdings to meaningfully measure variation in allocations. Fortunately, the correlations between the number of investors in the 13F holdings and the number receiving actual allocations are high. For all investors over the 6 IPOs, the series are 79% correlated. For key investors, the series are 87% correlated. These strong correlations suggests 13F holdings are picking up meaningful variation in investors' and key investors' allocations.

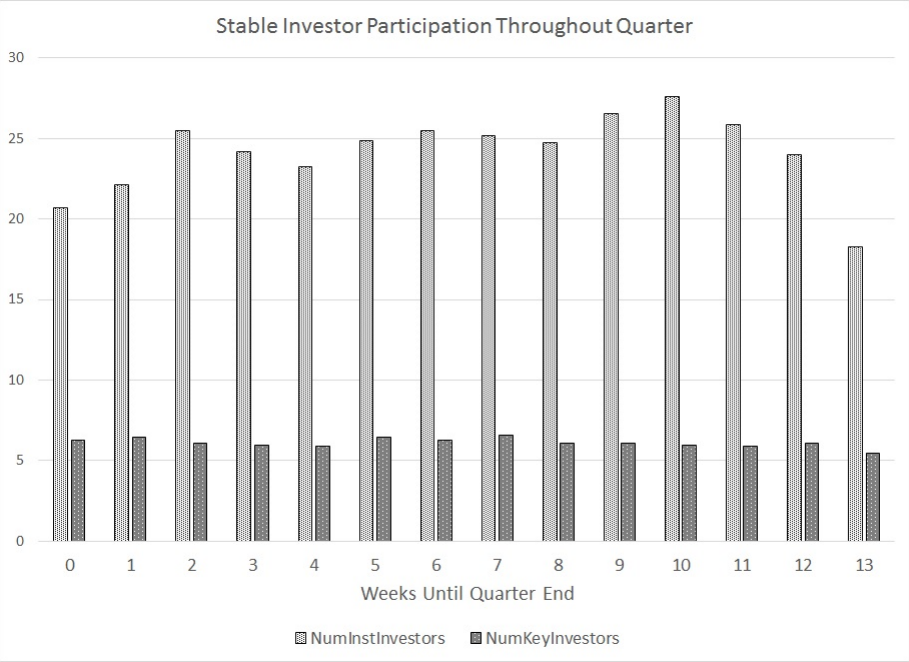
The allocations data also shows that key investors receive more shares and tend to buy additional shares after the IPO. Key investors on average receive 84K shares, while non-key investors receive 39K shares and new investors receive 20K shares. Both key and non-key investors tend to add to their positions after the IPO, doubling their holdings by the end of the year.

While comparing holdings to actual allocations suggests 13F holdings are a good proxy for allocations, it is also possible that holdings reflect systematic, secondary-market purchases of IPOs, particularly of hot IPOs. If key investors engage in this behavior more so than non-key investors, they would be associated with substantial underpricing due to their propensity to buy very underpriced stocks after the IPO and hold them until at least the end of the quarter. To test this possibility, we examine the relation between the number of investors and key investors holding shares at the end of the quarter and the time period between the IPO and the end of the quarter. IPOs that occur earlier in the quarter have more time for investors to purchase shares in the secondary market. Therefore, if key investors' post-IPO buying is driving our results, we would expect higher numbers of key investors (relative to non-key investors) for IPOs earlier in the quarter.

Figure 3 shows that there is no clear pattern in the number of key investors reporting holdings throughout the quarter. While there are slightly more reported holdings for IPOs earlier in the quarter, two observations lead us to believe that post-IPO buying does not significantly drive our results. First, the overall variation across weeks is large relative to the generally weak trend throughout the quarter. Second, the number of key investors tends to move with the number of total investors, suggesting that key investors are not disproportionately reporting holdings of IPOs earlier in the quarter.

Table 10 provides statistical evidence consistent with the weak trend in Figure 3: the number of non-key investors increases with the number of days remaining in the quarter. This is consistent with the allocations data in Table 9 showing a significant number of

Figure 3: The numbers of total investors and key investors reporting holdings display no clear patterns throughout the quarter.



non-allocation, end-of-quarter holdings. However, the number of key investors does not significantly increase throughout the quarter. Importantly, the number of key investors does not increase faster than the number of non-key investors. This is inconsistent with key investors' identification being due to post-IPO buying of hot IPOs. However, it does not rule out the possibility as key investors may be purchasing on the first day of the IPO, making within-quarter timing irrelevant. Given our complimentary evidence, we believe it is more likely that key investors' holdings predominantly reflect allocations rather than post-IPO buying.

Repeating our main analyses using an alternative measure based on money left on the table further supports our measure of key investors.[18] Using money left on the table incorporates the number of shares a fund reports in the 13F holdings, along with the underpricing in each offering. As a result, the measure may be more susceptible to post-IPO buying. Our tests suggest this may be the case. Using classifications based on money left on the table, the number of key investors does increase over the quarter.

Because the money-left-on-the-table measure will favor investors who report many shares, those with the largest reported holdings are more likely to be key investors. Interestingly,

[18]The supporting tables are available in the Online Appendix.

there is only a 20% correlation between our main measure of key investors and the measure using money left on the table.[19] This suggests a different set of investors, perhaps those more likely to be post-IPO buyers, are identified based on money left on the table. Importantly, using the money-left-on-the-table measure weakens our main results. Key investors' participation is less related to underpricing and offer price revisions, and key investors appear less informed. If post-IPO buying were driving our findings, the money-left-on-the-table measure would likely give stronger, not weaker results.

Several other points are worth making. We may be failing to identify the most important key investors if they sell their most underpriced IPOs before the end of the quarter, leaving them identified as non-key investors. If this is the case, then in future IPOs, those investors should be associated with even more underpricing if they are the true information providers. This would increase the effect for all investors and diminish the relative effect for key investors, biasing tests against finding a difference. Therefore, this source of bias does not challenge our conclusions.

If key investors are conveying information to underwriters during book-building, then it is likely that those investors are receiving allocations. For key investors to affect pricing, this need not be the case. For example, expressing interest to an underwriter may convey information, but underwriters do not reward all who express interest with allocations. This expression of interest by an investor reflects active participation in the IPO regardless of actual allocation. However, it is unlikely that funds would continue to provide information were they not awarded with allocations from time to time. Given the theory and evidence, we believe it is more likely than not that our results are driven by allocations and not post-IPO buying.

4.2 Bargaining Power

Another possible explanation for our results is that large fund families, with correspondingly large fees paid to investment banks, use their bargaining power to secure only the most underpriced offerings. For example, Fidelity may require that underwriters buy back shares of overpriced offerings. As a result, Fidelity's bargaining power, and not its information or value-adding activities, could lead to consistent abnormal underpricing. To test this alternative hypothesis, we classify key investors according to their tercile ranking for number of allocations (among key investors) and fund size (among the population of funds).

Table 11 shows the results using standardized variables for comparability. Column (1)

[19]The correlation between the mean and median measures is 69%.

provides a reference point, showing that a one-standard deviation increase in the number of key investors is associated with a 0.37 standard deviation increase in underpricing. Column (2) segments key investors based on their number of allocations over the past year. Terciles are formed based on the number of allocations within the group of key investors, as almost all key investors are in the top tercile of funds generally. The results show that the majority of the relation between underpricing and key investors' participation is driven by funds' receiving the most allocations. This is unsurprising, as the most informed or value-adding funds would likely be sought out in many offerings. Column (3) segments key investors based on funds' sizes (derived from reported 13F holdings). If bargaining power is driving our result, then it is likely that large funds will be responsible for the majority of the relation. However, the results show that medium-sized funds, the middle tercile, display the most significant relation between underpricing and key investors' participation. Both large and small funds also show significant relations, but the economic magnitude is slightly smaller for large funds and about 25% smaller for small funds. These results suggest that bargaining power is not the primary driver of our results.

4.3 Underwriter Relationships

Relationships between underwriters and funds may also drive our main results. For example, underwriters may allocate the offerings that are expected to be most underpriced to favored clients. Or, funds may take the underwriter as a signal of an IPO's quality and buy post-IPO. In either case, systematically reporting the holdings of IPOs sold by a particular underwriter could lead to our findings.

To analyze this possibility, we track underwriter-fund relationships over time. We consider a fund and underwriter to be related if the fund has reported holdings in at least 2 of the underwriter's last 10 IPOs (within the last 5 years).[20] For each IPO, we define $NumUWRelatedInv$ as the number of investors who report holdings and are related to the offering's underwriter. It is possible that the majority of key investors are also related investors, so we also construct $NumKeyUWRelatedInv$, which counts key investors who report holdings and are related to the underwriter. Interestingly, more related investors report holdings in IPOs than key investors. For the average IPO, 10.8 related investors report holdings and 6.3 key investors report holdings, of which, 3.9 are also related to the underwriter.

Table 12 shows that underpricing is positively related to key investors' participation but

[20] A similar measure is used in Gondat-Larralde and James (2008).

not to related investors' participation. Column (1) shows our baseline results for comparison, while Column (2) shows that, when excluding $NumKeyInvestors$, $NumUWRelatedInv$ is positively related to underpricing. This is likely due to a 70% correlation between the two measures. Column (3) shows that incrementally, $NumUWRelatedInv$ is negatively related to underpricing and $NumKeyInvestors$ is positively related to underpricing. Finally, we consider whether key investors who also have relationships with the underwriter are driving most of the positive relation. Column (4) shows this is not the case. Rather, the number of key investors who also have a relationship with the underwriter is less strongly related to underpricing than the number of key investors unrelated to the underwriter. Related key investors' frequent participation in an underwriter's offerings may allow that underwriter to lower underpricing as part of a repeated game as discussed in Benveniste and Spindt (1989). Altogether, these test suggest that underwriter-fund relationships are not driving the relation between key investors' participation and underpricing.

4.4 Agency-Based Explanations

Several of our prior tests suggest that key investors' participation in abnormally underpriced IPOs is unlikely to be motivated by them being favored by underwriters in exchange for future business or kickbacks. First, we have shown that investors' past relationships with an underwriter are negatively related to underpricing once key investors' participation is controlled for, suggesting that favoritism is not driving our results. Second, kickbacks-based arguments suggest that underwriters would favor a small number of trusted key investors in IPOs, particularly those with high underpricing. However, this not consistent with our finding that extreme underpricing happens when large numbers of key investors participate. Third, it would be easier for underwriters to transfer rents by giving many shares to favored investors rather than engage a large number of investors and ration each of them. Our results suggest the opposite: underpricing is strongly related to the number of key investors participating, but not the number of shares they hold. Finally, one would expect that underwriters would revise offer prices moderately in order to transfer more rent to favored key investors, which we do not find.

Underwriters' desires to lessen their own costs of price support is one agency-based motivation for key investors' participation in IPOs that does not directly contradict our findings. Underwriters typically attempt to keep the price of the firm above the opening price for several weeks or more after the IPO. To ease this process, underwriters can allocate shares to investors who implicitly commit to buying additional shares in the secondary market, an

illegal process called laddering. Hao (2007) shows that allocating more shares to laddering investors increases underpricing, so it is possible that key investors are those most likely to ladder and aid in the underwriter's price support activities. However, as in theories related to kickbacks, the shares held by key investors and not the number of key investors should be related to underpricing. Nevertheless, we conducted additional tests of the laddering hypothesis. In addition to overall key investors' participation, we separately included a measure of the participation of key investors who frequently sell their holdings in the quarter after the IPO, a behavior that is consistent with laddering. We found no significant difference between regular or frequently-selling key investors' participation and further attempts to relate frequently-selling key investors to laddering did not yield robust results. This suggests that laddering or price support by key investors is not driving our main results.

5 Robustness Tests

We use instrumental variables to further test whether industry specialization or underwriter relationships influence the relation between underpricing and key investors' participation. We also show that our results are robust to several alternative statistical definitions of key investors.

5.1 Instrumental Variables

Using an instrumental variable could establish causality and that 13F holdings reflect actual allocations. To do so, an instrument must only influence institutional investors before the IPO, as otherwise it could affect post-IPO buying.[21] However, we find it unlikely that an exogenous shock would deter professional investors from attending roadshows. Given the high expected returns associated with IPO allocations, investors' attention allocation likely favors IPOs, potentially undoing any meaningful exogenous shocks.

While a traditional instrumental variables analysis is unlikely in our setting, the instrumental variables approach can help to distinguish between underwriter-based and investor-based explanations for our findings. To instrument for realized investor participation (re-

[21] Liu, Sherman and Zhang (2014) provides one potential instrument, using special news reports to show that media coverage during the book-building period improves firms' valuations, liquidity, analyst coverage and institutional ownership. The instrument for media coverage, special news reports, coincides with major news events (such as the 1986 Challenger shuttle explosion) that likely shift attention away from IPO firms. Unfortunately, there is no significant relation between special news reports and total investors' nor key investors' participation in IPOs.

ported holdings), we use predicted investor participation from a probit model using data available before the IPO. By changing the variables used to predict holdings, we can test alternative explanations for the relation between key investors' participation and underpricing. For example, if underwriters are important to IPO pricing, then an instrument for key investors' participation constructed using predicted values based on underwriter-fund relationships may positively relate to underpricing.[22]

To test the alternative explanations, we follow Brown (2015) in estimating probit models of funds' end-of-quarter holdings. We consider four different sets of predicting variables: (i) only underwriter-fund relationships; (ii) underwriter-fund relationships and fund characteristics (e.g. size, age, and holdings-based measures); (iii) funds' industry specializations ($IndOverWt$); and (iv) funds' industry specializations and fund characteristics. All models also include the key-investor indicator variable and interaction terms with the indicator. From the probit estimations (which are not reported for brevity), funds with underwriter relationships and funds specialized in the IPO firm's industry are both more likely to report holdings, as are larger funds and key investors. Using the probit estimations, we calculate the predicted number of total and key investors reporting holdings in each IPO and then use these values to instrument for actual holdings. Table 13 reports the results of instrumental-variables regressions using the four different sets of predicting variables.

Panels A and B of Table 13 show the results when underwriter-fund relationships are used to construct the instruments. In both cases, the instruments meet the relevance criteria, but only at the 10% threshold. It is important to note that instruments constructed in this way have no within-quarter-underwriter variation. The reason is that underwriter relationships are calculated at the start of each quarter, and fund characteristics are at the quarterly reporting level as well. As a result, for each IPO of an underwriter in a quarter, the predicted numbers of key and total investors are the same. While this instrument doesn't allow individual firm characteristics to play a role, this provides an opportunity to test how much of our findings are attributable to the underwriters. We find that the instrumented-variable for all investors' participation is weakly related to underpricing in the second stage in one specification. All other instrumented variables are not significant, suggesting that the variation in realized participation that is related to expected variation due to underwriter-fund relationships is not important for IPO pricing. This is consistent with our earlier analysis on underwriter-fund relationships.

[22]Underwriters may be important to IPO pricing in a number of ways. As examples, Binay, Gatchev and Pirinsky (2007) finds underwriters often favor past participants and Hoberg (2007) provides evidence consistent with underwriters' being informed about IPO-firm quality.

Panels C and D of Table 13 show the results when funds' industry specializations are used to construct the instruments. In these cases, both instruments meet the relevance criteria easily with high statistical significance. In the second-stage, the instrumented variables are positively related to underpricing, consistent with funds' information being important for IPO pricing. To reiterate, when only funds' industry specializations are used to predict holdings, the associated variation in realized holdings is positively related to underpricing. This is consistent with the positive relation originating from the information possessed by funds. Interestingly, instrumented total investors' participation is positively related to underpricing as well. This suggests that non-key investors may contribute information to IPO pricing when they specialize in the IPO-firm's industry. Our instrumental variables analysis suggests that individual funds are more important to IPO pricing than underwriters.

5.2 Measure Robustness

Given that our definition of key investors relies on a chosen threshold, we repeat our main regressions using several alternative measures. Table 14 shows that using thresholds of 1% or 5%, median or mean abnormal underpricing, or an alternative measure based on money left on the table lead to similar conclusions. For comparability across measures, all variables have been standardized by subtracting their means and dividing by their standard deviations. The coefficients can therefore be interpreted as the expected increase in underpricing (in standard deviations, where one standard deviation is 36%) for a one-standard deviation increase in the independent variable. In each case, key investors' participation is the variable most significantly associated with underpricing, showing that our choice of statistical threshold is not driving our results. Overall, these tests suggest that we are identifying specific funds that are important to the IPO pricing process, and are not simply identifying a mechanical relation.

6 Concluding Remarks and Economic Significance

We identify key investors based on their past IPO participation and show that their participation in future IPOs is highly predictive of underpricing and offer price revisions. The majority of this relation appears to be due to key investors' informational advantages. We conclude by summarizing the economic value of underpricing to key investors.

Table 15 shows that key investors are rewarded substantially for the roles they play. Based on reported holdings and our definition of key investors, key investors receive 34%

of the total money left on the table in IPOs. Non-key investors make up a large portion of allocations and receive a large portion of money left on the table, despite their total participation being unrelated to underpricing. Because some shares must be allocated to investors who will immediately sell those shares (otherwise there would be no one to sell to buyers in the secondary market), and IPOs in the US must all be sold at the same price, it is not surprising that some benefits accrue to non-key investors. But are the benefits to non-key investors excessive? Given the existing evidence that underpricing benefits underwriters and investors at the expense of firms (e.g. Goldstein, Irvine and Puckett (2011), Nimalendran, Ritter and Zhang (2007), Reuter (2006), Ritter and Zhang (2007)), it is certainly possible that non-key investors are beneficiaries of such activity. While key investors are important for determining IPO pricing, it appears a large portion of the economic value of underpricing goes to other investors.[23] As a result, our analysis supports the role of information in determining underpricing, but does not rule out other explanations for underpricing, particularly those related to agency concerns.

Our analysis highlights the importance of a small group of key institutional investors to the IPO process. These key investors appear to aid in the price-formation process during and after the IPO, and may be beneficial to firms as part of their continuing ownership structure. Future research may identify other ways in which key institutional investors add value to firms.

[23]While using alternative versions of our measure gives quantitatively different estimates of economic value going to non-key investors, the general tenor of our results do not change: a large portion of value from underpricing accrues to non-key investors.

References

Agarwal, Vikas, Vyacheslav Fos and Wie Jiang. 2013. "Inferring Reporting-Related Biases in Hedge Fund Database from Hedge Fund Equity Holdings." *Management Science* 59(6):1271–1289.

Agarwal, Vikas, Wie Jiang, Yuehua Tang and Baozhong Yang. 2013. "Uncovering Hedge Fund Skill from the Portfolio Holdings They Hide." *Journal of Finance* 68(2):739–783.

Aggarwal, Rajesh K., Laurie Krigman and Kent L. Womack. 2002. "Strategic IPO Underpricing, Information Momentum, and Lockup Expiration Selling." *Journal of Financial Economics* 66(1):105–137.

Aggarwal, Reena, Nagpurnanand R. Prabhala and Manju Puri. 2002. "Institutional Allocation in Initial Public Offerings: Empirical Evidence." *The Journal of Finance* 57(3):1421–1442.

Banerjee, Suman, Robert S. Hansen and Emir Hrnjić. 2009. "IPO Underpricing to Attract Buy-and-Hold Investors." *Working Paper* .

Benveniste, Lawrence M., Alexander Ljungqvist, William J. Wilhelm, Jr. and Xiaoyun Yu. 2003. "Evidence of Information Spillovers in the Production of Investment Banking Services." *The Journal of Finance* 58(2):557–608.

Benveniste, Lawrence M. and Paul A. Spindt. 1989. "How Investment Bankers Determine the Offer Price and Allocation of New Issues." *Journal of Financial Economics* 24(2):343–361.

Binay, Murat M., Vladamir A. Gatchev and Christo A. Pirinsky. 2007. "The Role of Underwriter-Investor Relationships in the IPO Process." *Journal of Financial and Quantitative Analysis* 42(3):785–810.

Booth, James R. and Lena Chua. 1996. "Ownership Dispersion, Costly Information, and IPO Underpricing." *Journal of Financial Economics* 41(2):291–310.

Bradley, Daniel J. and Bradford D. Jordan. 2002. "Partial Adjustment to Public Information and IPO Underpricing." *Journal of Financial and Quantitative Analysis* 37(4):595–616.

Brown, David. 2015. "Investing in Security Price Informativeness: The Role of IPO Underpricing." *Working Paper* .

Bubna, Amit and Nagpurnanand R. Prabhala. 2011. "IPOs with and without Allocation Discretion: Empirical Evidence." *Journal of Financial Intermediation* 20(4):530–561.

Carter, Richard B., Frederick H. Dark and Ajai K. Singh. 1998. "Underwriter Reputation, Initial Returns, and the Long-Run Performance of IPO Stocks." *The Journal of Finance* 53(1):285–311.

Carter, Richard and Steven Manaster. 1990. "Initial Public Offerings and Underwriter Reputation." *The Journal of Finance* 45(4):1045–1067.

Chemmanur, Thomas J., Gang Hu and Jiekun Huang. 2010. "The Role of Institutional Investors in Initial Public Offerings." *The Review of Financial Studies* 23(12):4496–4540.

Chiang, Yao-Min, Yiming Qian and Ann E. Sherman. 2010. "Endogenous Entry and Partial Adjustment in IPO Auctions: Are Institutional Investors Better Informed?" *The Review of Financial Studies* 23(3):1200–1230.

Cliff, Michael T. and David J. Denis. 2004. "Do Initial Public Offering Firms Purchase Analyst Coverage with Underpricing?" *The Journal of Finance* 59(6):2871–2901.

Cornelli, Francesca and David Goldreich. 2001. "Bookbuilding and Strategic Allocation." *The Journal of Finance* 56(6):2337–2369.

Corwin, Shane A. and Paul Schultz. 2012. "A Simple Way to Estimate Bid-Ask Spreads from Daily High and Low Prices." *The Journal of Finance* 67(2):719–760.

Ellul, Andrew and Marco Pagano. 2006. "IPO Underpricing and After-Market Liquidity." *The Review of Financial Studies* 19(2):381–421.

Field, Laura C. and Jonathan M. Karpoff. 2002. "Takeover Defenses of IPO Firms." *Journal of Finance* 57(5):1857–1889.

Field, Laura Casares and Michelle Lowry. 2009. "Institutional versus Individual Investment in IPOs: The Importance of Firm Fundamentals." *Journal of Finanacial and Quantitative Analysis* 44(3):489–516.

Goldstein, Michael A., Paul Irvine and Andy Puckett. 2011. "Purchasing IPOs with Commissions." *Journal of Financial and Quantitative Analysis* 46(5):1193–1225.

Gondat-Larralde, Céline and Kevin R. James. 2008. "IPO Pricing and Share Allocation: The Importance of Being Ignorant." *The Journal of Finance* 63(1):449–478.

Hanley, Kathleen W. 1993. "The Underpricing of Initial Public Offerings and the Partial Adjustment Phenomenon." *Journal of Financial Economics* 34:231–250.

Hanley, Kathleen W. and William J. Wilhelm, Jr. 1995. "Evidence on the Strategic Allocation of Initial Public Offerings." *Journal of Financial Economics* 37(2):239–257.

Hao, Qing. 2007. "Laddering in initial public offerings." *Journal of Financial Economics* 85(1):102 – 122.

Hoberg, Gerard. 2007. "The Underwriter Persistence Phenomenon." *The Journal of Finance* 62(3):1169–1206.

Holmstrom, Bengt and Jean Tirole. 1993. "Market Liquidity and Performance Monitoring." *Journal of Political Economy* 101(4):678–709.

Ibbotson, Roger G., Jody L. Sindelar and Jay R. Ritter. 1975. "The Market's Problems with the Pricing of Initial Public Offerings." *Journal of Applied Corporate Finance* 7(1):66–74.

Jenkinson, Tim and Howard Jones. 2004. "Bids and Allocations in European IPO Bookbuilding." *The Journal of Finance* 59(5):2309–2338.

Kacperczyk, Marcin, Clemens Sialm and Lu Zheng. 2005. "On the Industry Concentration of Actively Managed Equity Mutual Funds." *The Journal of Finance* 60(4):1983–2011.

Liu, Laura Xiaolei, Ann E. Sherman and Yong Zhang. 2014. "The Long-Run Role of the Media: Evidence from Initial Public Offerings." *Management Science* 60(8):1945–1964.

Liu, Lauro Xiaolei, Ruichang Lu, Ann E. Sherman and Yong Zhang. 2015. "An Attention Model of IPO Underpricing, With Evidence on Media Coverage." *Working Paper*.

Ljungqvist, Alexander P. 2007. *IPO underpricing in: Eckbo, B.E. (Ed.), Handbook of Corporate Finance: Empirical Corporate Finance*. North Holland.

Ljungqvist, Alexander P. and William J. Wilhelm, Jr. 2002. "IPO Allocations: Discriminatory or Discretionary?" *Journal of Financial Economics* 65(2):167–201.

Loughran, Tim and Jay R. Ritter. 2002. "Why Don't Issuers Get Upset About Leaving Money on the Table in IPOs?" *Review of Financial Studies* 15(2):413–444.

Loughran, Tim and Jay R. Ritter. 2004. "Why Has IPO Underpricing Changed Over Time?" *Financial Management* 15(2):5–37.

Loughran, Tim, Jay R. Ritter and Kristian Rydqvist. 1994. "Initial public offerings: International insights." *Pacific-Basin Finance Journal* 2:165–199.

Mello, Antonio S. and John E. Parsons. 1998. "Going Public and The Ownership Structure of The Firm." *Journal of Financial Economics* 49(1):79–109.

Nimalendran, M., Jay R. Ritter and Donghang Zhang. 2007. "Do Today's Trades Affect Tomorrow's IPO Allocations?" *Journal of Financial Economics* 84(1):87–109.

Reuter, Jonathan. 2006. "Are IPO Allocations for Sale? Evidence from Mutual Funds." *The Journal of Finance* 56(5):2289–2324.

Ritter, Jay R. 2011. "Equilibrium in the Initial Public Offerings Market." *Annual Review of Financial Economics* 3:347–374.

Ritter, Jay R. and Donghang Zhang. 2007. "Affiliated Mutual Funds and the Allocation of Initial Public Offerings." *Journal of Financial Economics* 86(2):337–368.

Ritter, Jay R. and Ivo Welch. 2002. "A Review of IPO Activity, Pricing, and Allocations." *The Journal of Finance* 57(4):1795–1828.

Rock, Kevin. 1986. "Why New Issues Are Underpriced." *Journal of Financial Economics* 15(1-2):187–212.

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

Sias, Richard W., Laura T. Starks and Sheridan Titman. 2006. "Changes in Institutional Ownership and Stock Returns: Assessment and Methodology." *The Journal of Business* 79(6):2869–2910.

Sibo, Liu. 2014. "Performance Persistence of Institutional Investors in IPO Market: Evidence from China." *Working Paper* .

Stoughton, Neal M. and Josef Zechner. 1998. "IPO-mechanisms, Monitoring and Ownership Structure." *Journal of Financial Economics* 49(1):45–77.

Yan, Xuemin (Sterling) and Zhe Zhang. 2009. "Institutional Investors and Equity Returns: Are Short-term Institutions Better Informed?" *The Review of Financial Studies* 22(2):893–924.

Appendix: Variable Definitions

AUM: Total dollar value of a fund's positions reported in the 13F filings data.
AvgIPOHoldTime: The average number of quarters before a fund reports no holdings in a firm for which it reported holdings in the quarter following the IPO.
AvgSpread: Bid-ask spread estimator from Corwin and Schultz (2012), calculated using the first six-months of trading.
Churn: Measure of trading activity calculated following Yan and Zhang (2009).
ConcurrentIPOs: Number of IPOs issued in the same month as the IPO, as used in Ibbotson, Sindelar and Ritter (1975).
ConcurrentUnderpricing: Average underpricing of IPOs issued in the same month as the IPO, as used in Ibbotson, Sindelar and Ritter (1975).
DaysToQuarterEnd: The number of days between the IPO and the last day of the quarter.
Expansion: The percentage of primary shares issued relative to the shares outstanding after the IPO, as first used in Liu et al. (2015).[24]
FundAge: Number of years a fund has reported in the 13F filings data, starting in 1980.
LogAge: Natural logarithm of the firm's age at the time of the IPO based on founding dates from the Field-Ritter dataset used in Field and Karpoff (2002) and Loughran and Ritter (2004).
LogSize: Total dollar value of a fund's positions reported in the 13F filings data.
LongTerm: An indicator equal to one if an investor is in the bottom two-thirds of investors in the past year based on selling allocations in the quarter following the IPO.
Holder: An indicator equal to one if an investor is in the top third of investors in the past year based on holding IPOs through the end of the fourth quarter following the IPO.
IndOverWt: A standardized measure of a fund's concentration of holdings within an industry. Values over zero reflect overweighting relative to the average fund.
InitialNumAnalysts: Number of analysts issuing reports in the first month after the end of the quiet period.
InvPrice: The inverse of the filing-range midpoint.
InvSpecialization: *IndOverWt* averaged overall all investors reporting holdings in an IPO.
KeyInvestor: An indicator variable equal to one if a fund reported holdings over the last year representing statistically abnormal underpricing.

[24] *Overhang*, which is shares held by the firm's initial investors divided by the shares issued in the IPO, represents a combination of *Expansion* and *Retention*. Using *Overhang*, which was first documented in Bradley and Jordan (2002), as an alternative does not change our results.

$KeyInvSpecialization$: $IndOverWt$ averaged overall all key investors reporting holdings in an IPO.

$KeyInvestorSpecialists$: The number of key investors with $IndOverWt > 0$ who report holding a firm in the quarter after the IPO.

$MarketReturn$: Market return (CRSP value-weighted return) over the 15 trading days prior to the issue date.

$MarketStdDev$: Standard deviation of market returns (CRSP value-weighted returns) over the 15 trading days prior to the issue date.

$MoneyLeft$: $Shares \times OfferPrice \times Underpricing$

$NonKeyInvSpecialization$: $IndOverWt$ averaged overall all non-key investors reporting holdings in an IPO.

$NumInstInvestors$: The number of institutional investors participating in an offering.

E[$NumInstInvestors$]: The estimated number of institutional investors participating in an offering based on a probit estimation of allocation probabilities.

$\widehat{NumInstInvestors}$: Instrumented version of $NumInstInvestors$.

$NumKeyInvestors$: The number of institutional investors participating in an offering with $KeyInvestor = 1$.

$\widehat{NumKeyInvestors}$: Instrumented version of $NumKeyInvestors$.

E[$NumKeyInvestors$]: The estimated number of key institutional investors participating in an offering based on a probit estimation of allocation probabilities.

$NumKeyShortTerm$: The number of key investors participating in an offering who are also classified as $ShortTerm$.

$NumKeyUWRelatedInv$: The number of key investors participating in an offering who have reported holdings in at least 2 of the underwriter's last 10 offerings.

$NumUWRelatedInv$: The number of investors participating in an offering who have reported holdings in at least 2 of the underwriter's last 10 offerings.

$OfferPriceRevision$: Percentage change from the midpoint of the first offer price range to the final offering price. The positive relationship between underpricing and offer price revisions was first documented by Hanley (1993).

$OneYearNumAnalysts$: Number of analysts issuing reports in the month one year after an IPO's issuance.

$PercentInst$: Total holdings of institutions in the first reporting quarter divided by the number of shares issued. A similar measure (using more precise allocations data) is used in Ljungqvist and Wilhelm (2002).

$PosPriceRevision$: The minimum of $OfferPriceRevision$ and zero.
$Proceeds$: Natural logarithm of the total IPO proceeds adjusted to year 2000 dollars.
$Producer$: An indicator equal to one if an investor is in the top third of investors in the past year based on significant position increases in the three quarters following the IPO.
$PVGO$: The present value of growth options, a measure of valuation uncertainty used in Benveniste et al. (2003).
$Q1Return$: The return from the closing price on the first day to the last day of the quarter of the IPO.
$Q2Return$: The return from the closing price on the last day of the quarter of the IPO to the closing price on the last day of the following quarter.
$Retention$: The percentage of pre-IPO shares retained by the pre-IPO sharesholders, as first used in Liu et al. (2015).
$Selling$: The proportion of an investor's IPOs, over the last year, in which he reports holdings of the IPO stock at the end of the first quarter after the IPO, but reports no holdings at the end of the second quarter after the IPO.
$Shares$: The number of shares reported by a fund in the 13F filings in the quarter following the IPO (proxy for allocations).
$TechFirm$: Indicator variable equal to one if the firm's SIC code is in a technology sector as defined by Cliff and Denis (2004).
$TotalKeyInvShares$: The total number of shares key investors report holding at the end of the quarter following an IPO.
$Underpricing$: The return from the IPO offer price to the price at the end of the first day of trading.
$UnderwriterRank$: Carter Manaster rank originated in Carter and Manaster (1990), and further updated in Carter, Dark and Singh (1998) and Loughran and Ritter (2004). The data are taken from Jay Ritter's website.
$UWpremium$: Average abnormal underpricing for an underwriter over the five years preceding an IPO. This measure was first used by Hoberg (2007) as *UnderwriterPersistence*.
$VC-Backed$: Indicator variable equal to one if the firm is backed by a venture capital firm.

Table 1: Persistence of Key Investors. The first row uses our main measure of key investors, defined as those with boostrapped p-values for abnormal underpricing less than 1%, while the subsequent measures use alternative definitions, using means, medians or money left on the table, to test robustness. The second column shows the percentage of fund-year observations classified as key investors for each definition. The remaining columns track the number of years since an investor was classified as a key investor, and show the percentage of initial key investors still classified as key investors in that year. The expectation under a lack of persistence is equal to the overall percentage of key investors in the population, which is given in the second column.

		% Key Inv Retaining Classification After X Years									
Key Investor Measure	% of Investors	1	2	3	4	5	6	7	8	9	10
p-value(MeanUP) $< 1\%$	11	38	32	30	29	26	22	25	22	21	25
p-value(MeanUP) $< 5\%$	21	48	42	42	41	39	40	42	37	35	37
p-value(MedianUP) $< 1\%$	12	40	33	30	30	28	26	29	26	20	24
p-value(MedianUP) $< 5\%$	22	47	41	42	42	43	40	40	40	35	37
p-value(MoneyLeft) $< 5\%$	7	34	31	31	27	26	29	23	22	22	21
p-value(MoneyLeft) $< 10\%$	11	44	41	38	38	38	37	33	31	30	31
Best 10%	10	30	27	27	28	25	22	21	19	18	20
Worst 10%	10	22	18	16	17	12	13	12	17	13	7

Table 2: Fund Characteristics. Variable definitions are provided in the appendix. Robust t-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

	Key Investors	Non-Key Investors	Differences
AUM (billions)	\$23.3	\$12.4	\$10.9***
$FundAge$	45.2	40.0	5.2***
$Churn$	0.174	0.157	0.017***
Average $IPOHoldTime$	5.283	5.074	0.209
Percent Hedge Funds	20.1%	21.5%	-1.4%
Observations	776	6,111	

Table 3: Key investor summary data. Investors are ranked based on the number of years, at the beginning of which, they are identified as being a key investor. AUM represents assets under management. Only funds identified as key investors for at least 5 years are listed.

Fund Name	Num Years $KeyInv = 1$	Num Years in Sample	Number of Allocations	AUM (billions)
Most Frequent Key Investors:				
ESSEX INVESTMENT MANAGEMENT CO	16	26	1172	$1.5
DENVER INVESTMENT ADVR LLC	11	15	822	$3.8
PROVIDENT INV COUNSEL	10	23	656	$2.9
JANUS CAPITAL CORP	10	23	838	$99.2
TURNER INVESTMENT PARTNERS, IN	10	19	609	$15.8
GILDER GAGNON HOWE & CO LLC	10	11	236	$4.9
PUTNAM INVESTMENT MANAGEMENT	9	26	1351	$33.0
TCW ASSET MANAGEMENT COMPANY	9	24	936	$22.7
DRIEHAUS CAPITAL MANAGEMENT, I	9	18	280	$1.6
MASS FINANCIAL SERV CO	8	26	1438	$87.7
R S INVESTMENT MGMT INC	8	21	606	$9.5
DUNCAN-HURST CAP MGMT	8	17	616	$0.7
ALGER FRED MANAGEMENT	8	18	362	$13.7
BANKERS TR N Y CORP	7	27	1737	$153.0
BLACKROCK FINL MGMT (SSR&M)	7	21	1090	$17.8
AMERICAN EXP FINANCIAL ADVR	7	25	1132	$130.0
JUNDT ASSOCIATES INC.	7	15	175	$0.1
AMERICAN CENT COS	7	22	577	$47.9
AMERINDO INVESTMENT ADVR	7	12	171	$6.6
BAMCO INC	7	16	192	$15.2
BERGER ASSOCIATES INC	7	12	347	$8.1
LORD ABBETT & CO	7	19	391	$43.4
THE VANGUARD GROUP	7	15	1029	$502.0
AXA FINANCIAL, INC.	6	27	1289	$146.0
DREYFUS CORP	6	11	338	$4.6
INVESTMENT ADVISERS INC	6	17	404	$0.3
LOOMIS SAYLES & CO INC	6	22	383	$15.0
PNC BANK CORP	6	21	423	$39.6
HUSIC CAPITAL MANAGEMENT	6	17	525	$0.4
FIDELITY MANAGEMENT & RESEARCH	6	21	2028	$418.0
A I M MGMT GROUP INC	6	13	936	$58.6
ALLIANZ DRESDNER ASSET MGMT AM	6	15	412	$37.7
VAN WAGONER CAPITAL MANAGEMENT	6	9	216	$0.1
J. P. MORGAN INVT MGMT (US)	5	26	1478	$200.0
STRONG CAPITAL MANAGEMENT, INC	5	21	903	$15.0
FRANKLIN RESOURCES INC	5	20	678	$136.0
PRICE T ROWE ASSOCIATE	5	26	833	$222.0
CAPITAL RES & MGMT CO	5	16	184	$619.0
LIBERTY RIDGE CAPITAL, INC.	5	19	372	$0.5
STATE STR BK & TRUST CO BOSTON	5	18	534	$564.0
WADDELL & REED FINANCIAL, INC.	5	23	585	$34.4
BRINSON PARTNERS INC	5	17	216	$62.7
FORTIS ADVISERS INC	5	10	239	$6.2
SUNAMERICA ASSET MGMT	5	8	337	$1.0
PALANTIR CAPITAL INC	5	6	151	$1.3
ARBOR CAPITAL MANAGEMENT, LLC	5	13	134	$1.1
NEXT CENTURY GR INVESTORS, LLC	5	8	79	$2.3

Table 4: Regressions of underpricing on the number of participating key investors and control variables common to the IPO literature. Variable definitions are provided in the appendix. Robust t-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

	Underpricing					
	(1)	(2)	(3)	(4)	(5)	(6)
NumKeyInvestors	0.031***		0.017***	0.007***		0.017***
	(30.335)		(16.116)	(3.658)		(11.466)
$NumKeyInvestors^2 \times 10^{-1}$				0.004***		
				(4.981)		
TotalKeyInvShares					0.340***	0.027
					(11.020)	(0.684)
NumInstInvestors		0.005***	0.001*	0.001	0.004***	0.001**
		(10.795)	(1.940)	(1.275)	(9.710)	(2.178)
OfferPriceRevision		0.054	0.022	0.078**	0.012	0.019
		(1.516)	(0.626)	(2.280)	(0.338)	(0.563)
PosPriceRevision		1.180***	0.993***	0.923***	1.134***	0.996***
		(15.008)	(12.949)	(11.943)	(14.600)	(12.956)
UWpremium		0.123**	0.079*	0.075*	0.092*	0.078*
		(2.539)	(1.730)	(1.666)	(1.950)	(1.712)
UnderwriterRank		0.003	-0.003	-0.001	0.001	-0.003
		(1.028)	(-0.940)	(-0.372)	(0.194)	(-0.937)
LogAge		-0.014***	-0.011***	-0.012***	-0.012***	-0.011***
		(-4.746)	(-3.966)	(-4.312)	(-4.129)	(-3.945)
LogSize		-0.085***	-0.060***	-0.055***	-0.073***	-0.060***
		(-11.152)	(-8.668)	(-8.145)	(-9.920)	(-8.662)
VC-Backed		0.005	-0.000	0.002	0.002	-0.000
		(0.634)	(-0.021)	(0.223)	(0.283)	(-0.026)
TechFirm		0.013	0.006	0.008	0.008	0.006
		(1.479)	(0.740)	(1.013)	(0.919)	(0.719)
InvPrice		-0.548***	-0.362**	-0.374**	-0.463***	-0.362**
		(-3.254)	(-2.262)	(-2.331)	(-2.812)	(-2.261)
Retention		0.110***	0.070***	0.057***	0.098***	0.071***
		(4.420)	(3.107)	(2.590)	(4.106)	(3.123)
Expansion		-0.108***	-0.098***	-0.103***	-0.100***	-0.098***
		(-4.557)	(-4.179)	(-4.384)	(-4.248)	(-4.170)
PercentInst		-0.014	-0.020	0.003	-0.100***	-0.027
		(-0.769)	(-1.138)	(0.148)	(-5.494)	(-1.514)
ConcurrentIPOs		-0.000	-0.001***	-0.001***	-0.001*	-0.001***
		(-1.178)	(-3.362)	(-3.605)	(-1.835)	(-3.331)
ConcurrentUnderpricing		0.003***	0.003***	0.003***	0.003***	0.003***
		(6.050)	(5.325)	(4.898)	(6.055)	(5.356)
MarketReturn		4.309*	4.539**	4.599**	4.419**	4.540**
		(1.941)	(2.139)	(2.183)	(2.020)	(2.139)
MarketStdDev		0.918	2.203	2.315*	1.109	2.172
		(0.637)	(1.590)	(1.702)	(0.784)	(1.568)
AvgSpread		2.260***	1.788***	1.729***	2.038***	1.787***
		(5.525)	(4.688)	(4.562)	(5.071)	(4.680)
InitialNumAnalyst		-0.015***	-0.014***	-0.013***	-0.014***	-0.014***
		(-3.313)	(-3.240)	(-2.986)	(-3.237)	(-3.237)
OneYearNumAnalyst		0.011***	0.009***	0.009***	0.010***	0.009***
		(4.103)	(3.346)	(3.364)	(3.700)	(3.341)
Year Dummies	No	Yes	Yes	Yes	Yes	Yes
R^2	0.423	0.596	0.634	0.639	0.613	0.634
Observations	4,928	4,928	4,928	4,928	4,928	4,928

Table 5: Regression of underpricing on average industry weights of investors reporting holdings. Variable definitions are provided in the appendix. Robust t-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

	Underpricing							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
NumKeyInvestors	0.017***	0.018***	0.017***	0.017***	0.017***	0.015***	0.010***	0.020***
	(16.059)	(16.136)	(15.900)	(15.944)	(15.792)	(11.566)	(3.904)	(14.833)
NumInstInvestors	0.001**	0.001**	0.001**	0.001**	0.000	0.001**	0.001**	0.001*
	(2.091)	(1.982)	(2.032)	(2.052)	(1.071)	(2.576)	(2.493)	(1.802)
InvSpecialization	0.022***				-0.012			
	(2.694)				(-0.982)			
NonKeyInvSpecialization		0.012		0.007		0.010		
		(1.280)		(0.752)		(1.130)		
KeyInvSpecialization			0.018**	0.016**		-0.031***		
			(2.405)	(2.165)		(-3.324)		
InvSpecialization × *NumInstInv*					0.002***			
					(2.798)			
NonKeyInvSpecialization × *NumNonKeyInv*						0.003		
						(1.044)		
KeyInvSpecialization × *NumKeyInv*						0.009***		
						(4.475)		
PVGO							-0.052***	
							(-4.817)	
PVGO × *NumKeyInvestors*							0.009***	
							(3.446)	
PosEarningsDummy								0.035***
								(4.691)
PosEarningsDummy × *NumKeyInvestors*								-0.006***
								(-4.244)
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.634	0.634	0.634	0.634	0.635	0.638	0.634	0.637
Observations	4,928	4,928	4,928	4,928	4,928	4,928	4,544	4,928

Table 6: Regressions of offer price revisions on the number of participating key investors and control variables common to the IPO literature. Variable definitions are provided in the appendix. Robust t-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

	OfferPriceRevision		
	(1)	(2)	(3)
NumKeyInvestors	0.014***		0.008***
	(37.855)		(15.970)
LogAge		-0.014***	-0.012***
		(-7.634)	(-6.544)
LogSize		-0.075***	-0.059***
		(-17.054)	(-13.540)
VC-Backed		0.010**	0.006
		(2.243)	(1.416)
TechFirm		0.030***	0.024***
		(6.247)	(5.264)
AvgSpread		1.516***	1.179***
		(6.744)	(5.405)
InitialNumAnalyst		-0.009***	-0.008***
		(-3.869)	(-3.367)
OneYearNumAnalyst		0.005***	0.004***
		(4.257)	(3.157)
InvPrice		-3.598***	-3.327***
		(-37.628)	(-35.445)
Retention		0.019	-0.003
		(1.036)	(-0.146)
Expansion		0.003	0.010
		(0.197)	(0.731)
UWpremium		0.206***	0.172***
		(8.946)	(7.782)
UnderwriterRank		-0.019***	-0.021***
		(-11.962)	(-13.545)
ConcurrentIPOs		0.000	-0.000
		(1.487)	(-0.397)
ConcurrentUnderpricing		0.002***	0.002***
		(10.911)	(9.194)
MarketReturn		-0.217	-0.177
		(-0.181)	(-0.152)
MarketStdDev		-2.586***	-1.905**
		(-2.870)	(-2.166)
PercentInst		-0.115***	-0.112***
		(-12.323)	(-12.429)
NumInstInvestors		0.005***	0.003***
		(23.074)	(11.363)
Year Dummies	No	Yes	Yes
R^2	0.309	0.524	0.555
Observations	4,928	4,928	4,928

Table 7: 3-Month Abnormal Returns following quarterly 13F holdings changes. Panel A presents cumulative 4-factor abnormal returns and Panel B presents buy-and-hold 4-factor abnormal returns. ΔX measures the change in the number of investors of type X holding shares over the prior quarter. Returns do not incorporate reporting delays in 13F filings and instead take positions at the beginning of each quarter. Variable definitions are provided in the appendix. Robust t-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

Panel A			
	Four-Factor CARs		
	(1)	(2)	(3)
Δ *NumInstInv*	0.001**	-0.001	-0.001
	(1.974)	(-1.596)	(-1.322)
Δ *NumKeyInvestors*		0.007***	-0.000
		(4.156)	(-0.041)
Δ *NumKeySpecialists*			0.011**
			(2.383)
Observations	4,870	4,869	4,870
Panel B			
	Four-Factor BHARs		
	(1)	(2)	(3)
Δ *NumInstInv*	0.001**	-0.001	-0.001
	(2.101)	(-1.337)	(-1.094)
Δ *NumKeyInvestors*		0.007***	0.000
		(3.919)	(0.072)
Δ *NumKeySpecialists*			0.009**
			(2.120)
Observations	4,870	4,869	4,870

Table 8: First-quarter (from close-of-first-day to end-of-quarter) average-daily returns for IPO stocks. The average daily return is expressed as a percentage. The sample size is reduced due to a number of IPOs that occur on the last day of the quarter. Variable definitions are provided in the appendix. Robust t-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

	% Return From First-Day Close To Quarter End			
	(1)	(2)	(3)	(4)
Underpricing		0.565		
		(1.044)		
NumInstInvestors			0.006	
			(1.054)	
NumKeyInvestors				0.025
				(1.480)
Constant	-0.294**	-0.325**	-0.540**	-0.398**
	(-2.104)	(-2.424)	(-1.986)	(-2.507)
Year Dummies	Yes	Yes	Yes	Yes
R^2	0.024	0.025	0.025	0.025
Observations	4,876	4,876	4,876	4,876

Table 9: Comparison of 13F holdings to actual allocations in 6 IPOs. Non-key investors are those who have had at least 4 IPO allocations in the past year, but without statistically significant average abnormal underpricing. New funds are those with fewer than 4 IPOs over the past year.

	Investors			
	Key	Non-Key	New	Total
Actual Allocations				1,395
Matched to 13F Funds	166	383	122	671
Matched to Holdings	71	57	2	130
13F Holdings				
Non-Allocations	66	51	7	124
Total Reported 13F Holdings	137	108	9	254
Correlations	87%	52%	19%	79%
Avg. Shares Received	83,774	39,430	19,516	
Avg. Post-IPO Trading	+99%	+103%	+0%	

Table 10: Relations between number of days from the IPO to the end of the quarter and the number of key investors and non-key investors reporting holdings in the 13F filings. Robust t-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

	(1) *NumKeyInvestors*	(2) *NumNonKeyInvestors*	(3) $\frac{NumKeyInvestors}{NumNonKeyInvestors}$
DaysToQuarterEnd	0.005	0.049***	-0.040
	(1.313)	(6.504)	(-1.449)
Constant	10.151***	40.777***	29.588***
	(4.015)	(6.970)	(3.961)
Year Dummies	Yes	Yes	Yes
R^2	0.320	0.245	0.233
Observations	4,928	4,928	4,928

Table 11: Regression of underpricing on key investors divided into separate classifications. Column (2) separates investors based on the number of IPOs with reported holdings over the prior 12 months. Column (3) separates investors based fund size (aggregate value of reported 13 holdings). For comparability, variables have been standardized by subtracting their mean values and dividing by their standard deviations. Variable definitions are provided in the appendix. Robust t-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

	Underpricing		
	(1)	(2)	(3)
NumKeyInvestors	0.372***		
	(16.117)		
NumKeyInv:HighAlloc		0.279***	
		(11.319)	
NumKeyInv:MedAlloc		0.091***	
		(5.736)	
NumKeyInv:LowAlloc		0.067***	
		(3.640)	
NumKeyInv:LargeSize			0.155***
			(5.934)
NumKeyInv:MedSize			0.166***
			(7.675)
NumKeyInv:SmallSize			0.119***
			(6.419)
Additional Controls	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes
R^2	0.634	0.636	0.640
Observations	4,928	4,928	4,928

Table 12: Regression of underpricing on key investors and investors' having relationships with underwriters. Variable definitions are provided in the appendix. Robust t-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

	Underpricing			
	(1)	(2)	(3)	(4)
NumInstInvestors	0.001*	0.004***	0.001**	0.000
	(1.938)	(7.074)	(2.555)	(0.763)
NumKeyInvestors	0.017***		0.018***	0.023***
	(16.117)		(16.267)	(10.619)
NumUWRelatedInv		0.002***	-0.001*	0.001
		(2.934)	(-1.827)	(1.230)
NumKeyUWRelatedInv				-0.009***
				(-3.062)
Additional Controls	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
R^2	0.634	0.597	0.634	0.635
Observations	4,928	4,928	4,928	4,928

Table 13: Instrumental variables regressions. Panels A through D show results from first and second-stage regressions using different versions of predicted investors' and key investors' participation as instruments for realized participation. Variable definitions are provided in the appendix. Robust t-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels. Each regression includes additional control variables, year dummy variables and 4,928 observations.

Panel A: Only Underwriter Relationships

	First-Stage		Second-Stage
	(1) *NumInstInvestors*	(2) *NumKeyInvestors*	(3) *Underpricing*
E[NumInstInvestors]	0.028	-0.178***	
	(0.880)	(-13.644)	
E[NumKeyInvestors]	0.231***	1.088***	
	(3.606)	(41.911)	
$\widehat{NumInstInvestors}$			0.015
			(1.412)
$\widehat{NumKeyInvestors}$			0.003
			(0.887)
R^2	0.761	0.740	0.519

Panel B: Fund Characteristics Plus Underwriter Relationships

	First-Stage		Second-Stage
	(1) *NumInstInvestors*	(2) *NumKeyInvestors*	(3) *Underpricing*
E[NumInstInvestors]	0.062	-0.217***	
	(1.457)	(-12.716)	
E[NumKeyInvestors]	0.224***	1.125***	
	(3.463)	(43.349)	
$\widehat{NumInstInvestors}$			0.015*
			(1.660)
$\widehat{NumKeyInvestors}$			0.002
			(0.891)
R^2	0.762	0.745	0.519

Panel C: Only Industry Specialization

	First-Stage		Second-Stage
	(1) *NumInstInvestors*	(2) *NumKeyInvestors*	(3) *Underpricing*
E[NumInstInvestors]	4.124***	0.129***	
	(36.236)	(2.786)	
E[NumKeyInvestors]	-3.233***	1.155***	
	(-26.906)	(23.573)	
$\widehat{NumInstInvestors}$			0.003***
			(4.328)
$\widehat{NumKeyInvestors}$			0.012***
			(10.490)
R^2	0.817	0.797	0.629

Panel D: Fund Characteristics Plus Industry Specialization

	First-Stage		Second-Stage
	(1) *NumInstInvestors*	(2) *NumKeyInvestors*	(3) *Underpricing*
E[NumInstInvestors]	1.816***	0.127***	
	(24.297)	(4.379)	
E[NumKeyInvestors]	-0.468***	1.144***	
	(-6.734)	(42.540)	
$\widehat{NumInstInvestors}$			0.007***
			(6.898)
$\widehat{NumKeyInvestors}$			0.010***
			(7.820)
R^2	0.792	0.792	0.610

Table 14: Robustness tests of our definition of key investors. These results replicate columns 1 and 2 from Table 5 for alternative definitions of key investors. Columns (1) and (2) repeat those results for reference. Columns (3) and (4) use an alternative definition considering a threshold cut-off of 5% rather than 1%. Columns (5) through (8) are similar to (1) through (4), but median underpricing is used to evaluate funds rather than mean underpricing. Columns (9) through (12) use money left on the table, rather than underpricing, to classify key investors. Variable definitions are provided in the appendix. Robust t-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

	Underpricing											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
p-value(MeanUP) < 1%	0.650***	0.372***										
	(30.335)	(16.114)										
p-value(MeanUP) < 5%			0.623***	0.430***								
			(28.740)	(17.602)								
p-value(MedianUP) < 1%					0.611***	0.345***						
					(29.237)	(16.234)						
p-value(MedianUP) < 5%							0.581***	0.354***				
							(27.478)	(16.113)				
p-value(MoneyLeft) < 5%									0.489***	0.184***		
									(24.124)	(9.286)		
p-value(MoneyLeft) < 10%											0.493***	0.212***
											(24.658)	(10.355)
NumInstInvestors		0.044*		-0.036		0.052**		0.008		0.166***		0.125***
		(1.941)		(-1.507)		(2.284)		(0.338)		(6.288)		(4.560)
Additional Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Year Dummies	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.423	0.634	0.388	0.634	0.373	0.628	0.338	0.624	0.239	0.607	0.243	0.607
Observations	4,928	4,928	4,928	4,928	4,928	4,928	4,928	4,928	4,928	4,928	4,928	4,928

Table 15: Summary statistics of underpricing, end-of-quarter holdings (our proxy for allocations) and holdings-implied money left on the table to different classifications of investors. Key investors experienced statistically-significant abnormal underpricing at a 1% threshold over the prior 12 months. New funds are those with fewer than 4 IPOs over the past year.

	Key Investors	Non-Key Investors	New Investors
Average Underpricing	59%	23%	18%
Average Shares Held	184,097	178,446	353,065
Average MoneyLeft	$1,059,552	$567,089	$991,599
Observations	32,428	89,176	16,168
(percent)	24%	65%	12%
Total Money Left ($B)	$34.4	$50.6	$16.0
(percent)	34%	50%	16%