Hedge Funds and Their Prime Brokers: Favorable IPO Allocations

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Abstract

Do hedge funds receive special treatments from their prime brokers in IPO allocations? Using a comprehensive data set, we examine investment banks' allocations of IPOs to their hedge fund clients. We find that investment banks/prime brokers that have business relationships with hedge funds tend to allocate more IPOs to them when those banks are the lead underwriters. Moreover, the size of allocations to hedge funds is larger when IPOs are underpriced, and the allocations are larger during bear equity markets. We document that younger funds or funds with recent poor performance tend to receive relatively larger allocations of underpriced IPOs. The size of these allocations is determined by the strength of the funds' relationships with their prime brokers, rather than by the level of their managers' skill. This is supported by the finding that even after receiving relatively large allocations of underpriced IPOs, these funds fail to generate significant alphas.

Keywords: Hedge funds, Prime brokers, IPO allocations, Relationships.

JEL Classification: G23, G24

Key Findings

- Investment banks that act as prime brokers for hedge funds and are lead underwriters of IPOs tend to allocate larger amounts of underpriced IPOs to their hedge fund clients.
- Investment banks tend to allocate a larger amount to their clients during bear equity markets, with younger funds and those with poor recent performance receiving relatively larger allocations.
- Investment banks reward those clients that have stronger relationship with them. The skills of hedge fund managers do not drive the favorable allocations.

Hedge funds are lucrative clients for investment banks.[1] Most investment banks offer prime brokerage services to hedge funds, and hedge funds rely on these services to manage their clients' assets. In return, investment banks earn significant income by offering services, such as securities lending, margin financing, and settlement facilities (Bryce 2008).[2] As a result, prime brokers aggressively compete with each other to secure hedge funds as clients. A central question is whether the incentives to initiate and maintain the prime brokerage business relationships drive investment banks to use their connections and market power to help their hedge fund clients by providing them with profitable investment opportunities.[3] In this paper, we study whether investment banks use their positions as lead underwriters of IPOs to help their hedge fund clients. Also, we examine the timing and the factors that affect the level of support offered by investment banks.

Hedge funds are reported as the fastest growing IPO investors in the U.S. IPO market. According to a survey by PwC 2016,[4] the participation of hedge funds in U.S. IPOs has been increasing at a rate of 3% per year since 2013 and reached 24% in 2015. Despite the popularity of IPO allocations to hedge funds, little empirical evidence has been provided on the potential size of these allocations, factors that determine its potential size, and its impact on hedge fund performance.

We use the following two terms to distinguish between hedge funds that are clients of lead underwriters of an IPO and those that are not: *Lead Prime Broker* and *Lead Client Fund*. *Lead Prime Broker* refers to a prime broker that is owned by an investment bank that is the lead underwriter of an IPO. Other prime brokers are referred to as *non-lead prime brokers. Lead Client Fund* refers to a hedge fund that is a client of a *lead prime broker*. Other hedge funds are referred to as *non-lead client funds.*

For rewarding their hedge fund clients, prime brokers receive benefits through three channels. First, the prime broker helps a client survive, and, therefore, preserve the future income stream that will be generated by that client. Second, the lead prime broker signals to other hedge funds, existing or start-up funds, about its support for its clients, helping it attract new clients. Third, many prime brokers are associated with private banks. These private banks often allocate their clients' capital to hedge funds with which they already have an existing relationship.[5] This helps reduce due diligence cost and operational risks associated with those funds. By helping these funds improve their performance, the prime broker and its affiliated private banks can attract

[1] "Investment Banks Are Too Dependent on Hedge Funds", Bloomberg News, 23 March 2005, sec. FP, FP13. Moreover, according to Greenwich Associates, Wall Street collects $33 million a year in trading commissions from the average hedge fund versus $16 million from the average mutual fund.

[2] According to "Unsettled on Wall Street" Institutional Investor Magazine, 14 October 2003 and "Hey Big Spender, Analysts on Call" International Herald Tribune, 6 March 2007, Hedge fund trading volume accounts for 40 to 50 percent of the daily trading volume in U.S. stock markets (Cox 2006).

[3] Recently, the SEC has begun to look into allocations of IPOs to hedge funds; https://www.bloomberg.com/news/articles/2017-06-30/sec-said-to-scrutinize-hedge-funds-handling-of-hot-ipo-shares.

[4] See "Considering an IPO? A continuing series Insight into the mindset of institutional IPO investors in the U.S.", PwC, May 2016.

[5] In our unreported results, we find that receiving larger allocations of underpriced IPOs is associated with subsequent fund inflows, suggesting that prime brokers help their clients with capital formation and introduction.

additional business.[6]

This study consists of two parts. First, we use issue-level data to document the pattern of IPO allocations by lead prime brokers. We find that lead prime brokers are more likely to allocate IPOs to lead client funds. The average allocations by lead prime brokers are not constant through time: After controlling for the number of IPOs issued each year, we find that they are more than 10 times higher during the bearish periods (2001-2003 and 2008-2009). That is, lead prime brokers provide more support to lead client funds when markets are performing poorly. We also explore the relationship between the underpricing of the IPO and its relative allocation to lead client funds. Our results suggest that these funds are more likely to receive allocations of underpriced IPOs from lead prime brokers. Besides, the greater the degree of underpricing, the greater the probability that a lead client fund will receive IPO allocations from its lead prime broker.

Next, we use fund-level data to study the characteristics of lead client funds and the IPO allocations that they receive. In addition to accounting for the presence of hedge fund-prime broker relationships, we take into account characteristics of both the hedge fund (e.g., its size or age) and the IPO issue (e.g., its pricing). We explore the role of the hedge fund manager's skill in obtaining IPO allocations. We find that the manager's skill is not relevant in obtaining a larger share of IPOs. On the contrary, connections matter and lead client funds tend to receive larger IPO allocations and disproportionately more underpriced issues from lead prime brokers. Our results suggest that underpriced IPOs are "pushed" by lead prime brokers on their clients rather than being identified and "pulled" by lead client funds.

According to the agency-based theory (Loughran and Ritter 2002; Reuter 2006), lead underwriters use allocations of underpriced IPOs to reward investors with which they have strong business relationships. Therefore, we include three proxies for the closeness and the strength of the relationships between lead client funds and lead prime brokers: multiple connections to lead prime brokers, the use of influential lead prime brokers, and the participation in hot IPOs. We define hot IPOs as the IPOs with positive initial returns. We find that while the use of multiple or top prime brokers leads to more IPO allocations to lead client funds, it leads to smaller IPO allocations from other prime brokers. The IPO allocations from lead prime brokers increase further when hot IPOs are considered. Also, we find that hedge funds receive relatively larger allocations of underpriced IPOs if they have more relationships with lead prime brokers or connect to a smaller amount of top prime brokers. As a result, prime brokers (especially large ones) reward those clients who do not diversity among other brokers and instead have an exclusive relationship with them. The paper documents that younger funds and lead client funds with poor recent performance receive favorable allocations (e.g., underpriced IPOs). Similar to the results reported above regarding increased support during bear markets, these results suggest that prime brokers have strong incentive to help funds survive and grow.

A few recent papers have examined the relationship between prime brokers and hedge funds. Kumar, Mullally, Ray, and Tang (2020) show that hedge funds receive non-public informa-

[6]Sun, Wang, and Zheng (2018) show that hedge fund performance persists following periods of relative hedge fund market distress. Their findings suggest that hedge funds doing well in difficult times tend to attract investors' flows subsequently.

tion from their prime broker banks regarding the banks' corporate borrowers and make informed trades based on it. Aragon, Chung, and Kang (2020) find that funds of hedge funds (FOFs) exhibit a stronger preference for hedge funds serviced by their connected prime brokers. Klein, Saunders, and Wong (2019) show a positive relationship between large hedge funds' trading imbalance and the upcoming upgrades/downgrades originating from the hedge funds' prime broker firms. Chung and Kang (2016) show a strong co-movement in the returns of hedge funds sharing the same prime broker, perhaps because their trades are based on the information received from the same prime brokers.

Qian and Zhong (2018) study the post-IPO stock holdings of hedge funds when their prime brokers serve as IPO underwriters and report higher abnormal returns on such stocks than those of other stocks. While there are several overlaps between this study and ours, there are also significant differences between the two. First, unlike Qian and Zhong (2018), our paper's focus is on (a) the role of hedge fund-prime broker relationship in determining IPO allocations and (b) characteristics of hedge funds and IPOs that affect this relationship. In particular, we show that the likelihood and size of favorable allocations are affected by market conditions. Equally important, we find that younger funds are more likely to receive favorable allocations, and so do funds with recent poor performance. Finally, we offer evidence that even with the benefit of receiving relatively large allocations of underpriced IPOs, lead client funds do not display positive abnormal performance, providing indirect evidence that these funds lack the skills to identify underpriced issues.[7]

Data and Sample Characteristics

We compile a comprehensive database by extensively matching data from Lipper TASS hedge fund database, Securities and Exchange Commission (SEC) 13F filings, and Securities data Companies (SDC) database.

We identify IPOs offered between Jan 1994 and Dec 2012 from the SDC New Issues database, excluding American Depository Receipts, unit offerings, closed-end funds, real estate investment trusts (REITs). We also exclude IPOs with offer prices less than $5, and IPOs that are missing the first six days of information from the Center for Research in Security Prices (CRSP), leaving 5,241 IPOs in our sample. We obtain IPO related data, including the offer price, initial price range, first-day closing price, shares, underwriter syndicate (including the lead underwriters), and SIC code from the SDC database. We use CRSP to fill in any missing first-day closing prices.

Since data on IPO allocations to hedge funds are not publicly available, we construct proxies

[7]Our paper is also related to the research on the determinants of IPO allocations to institutional investors. Two main theories have been set forward to explain underpricing of IPOs: 1) according to Benveniste and Spindt (1989), information asymmetry leads underwriters to allocate underpriced IPOs to reward investors for revealing their information about the IPO price; 2) Loughran and Ritter (2002) and Reuter (2006) argue that underwriters use underpriced IPOs to curry favor with their institutional clients, and these investors reward underwriters through increased businesses.

for IPO allocations using equity holdings of hedge funds from the same period. First, we use TASS database to create our sample of hedge funds and hedge fund management companies. TASS provides information on monthly hedge fund returns, assets under management (thereafter, AUM), and other fund-specific information. More importantly, it provides information on prime brokers, which is crucial in our attempt to identify clients of specific prime brokers.

Second, we identify hedge fund equity holdings based on institutional holdings from 13F filings to the SEC. As a private investment company, hedge funds with more than $100 million under management must report their holdings to the SEC each quarter on Form 13F, including all long positions (but no short position) in the U.S. stocks and a few other securities greater than 10,000 shares or $200,000 in the market value. Holdings are reported at the management company level at the end of each calendar quarter.

Following the methodology of Brunnermeier and Nagel (2004) and Griffin and Xu (2009), we compile a list of hedge fund management companies from TASS hedge fund databases and manually match them with the companies registered as investment advisers from 13F database. If a firm is not registered, we include it in the sample, since registration is a prerequisite for conducting non-hedge fund business such as advising mutual funds and pension plans. If the firm is registered, we obtain its ADV form and check its eligibility for the sample based on two criteria: (1) at least 50% of its clients are Other Pooled Investment Vehicles (e.g., hedge funds) or High net worth individuals, and (2) it charges a performance fee for its advisory services. This process leaves us with 380 hedge fund management companies and 25,633 total stock holdings.

To identify hedge fund holdings in long positions, we focus solely on hedge funds using long/short equity hedge, equity market neutral, and event-driven strategies. To mitigate a potential survivorship bias, we use both "Live" and "Graveyard" funds in TASS database starting in 1994. Since holdings data are at the company level, we elevate fund-level characteristics to the company-level to satisfy the consistency requirements. For example, a hedge fund management company's AUM is calculated as the average of AUMs of all hedge funds managed by the company at each time point.

In TASS, prime brokers are cross-sectionally identified at the fund level, and a hedge fund may be associated with one or more prime brokers. Since a hedge fund management company often manages multiple hedge funds, we use all the listed prime brokers within the same management company. We exclude funds that do not report information on their prime broker affiliations. Over the past ten years, the prime brokerage industry has been dominated by top investment banks. Using the snapshot of TASS database from 2006 to 2012, we find that the ten largest brokers account for about 80% of the market share in the hedge funds business. These prime brokers ranked according to their market share in our sample, are, respectively, Goldman Sachs, Morgan Stanley, JP Morgan Chase, UBS, Deutsche Bank, Credit Suisse, Bank of America, Citi, Merrill Lynch, and Lehman Brothers[8]. We further examine the prime broker turnover using yearly snapshots of the TASS database from 2006 to 2012. We do not find significant changes of prime brokers for each hedge fund management company, and neither do the changes of multiple prime brokers over

[8]Lehman Brothers filed for bankruptcy on September 15, 2008. Therefore, we exclude the associated hedge funds on and after 2008 from our sample.

these years. As the relationships between hedge funds and prime brokers are relatively stable in this sample, we use prime broker data in 2006 snapshot for the time-series sample construction before 2006. After these filtering procedures, 125 hedge fund management companies with 81 prime brokers and 1,160 IPOs with the associated 295 lead underwriters are identified in our compiled database.

Exhibit 1 reports the summary statistics of our sample based on the merged TASS, SDC, and 13F data. Among IPOs issued from 1994 to 2012, 1,160 have hedge fund ownership at the end of the quarter in which IPOs take place. The reported statistics in Panel A include the number of IPOs, offer price, shares offered, offer proceeds, initial IPO return, and pre-IPO demand. The initial IPO return, which is the day one return of IPO measured from the offer price to the first-day closing price, is 30.61% in our sample. We partition IPOs owned by hedge funds into hot versus cold IPOs using zero initial return as a cutoff. As a result, the average initial return for hot and cold IPOs is 35.81% and -8.18%, respectively. We examine hot versus cold IPOs for most of our results throughout this paper. The pre-IPO demand, calculated as the percentage difference between the midpoint of the filing price range and the offer price, is 12.68% on average, and the pre-IPO demand for hot IPOs is higher than that for cold IPOs. As expected, the offer proceeds from hot IPOs are higher than those from cold IPOs.

Exhibit 1 Panel B reports hedge fund characteristics at the company-level, including alpha, AUM, return, flow, age, and volatility. There are 125 hedge fund management companies in our sample managing 767 individual hedge funds using long/short equity hedge, equity market neutral, or event-driven strategies. The average number of prime brokers used per company is 3, and 65% of the sample funds report that they use at least one prime broker. It is important to note that it is highly likely that more than 65% of funds use at least one prime broker. We do not know why certain funds choose not to report whether they are using prime brokers or not, and we have no reason to believe that the available sample inserts systematic biases into our results.

Each quarter we estimate each hedge fund's alpha by regressing the net-of-fee monthly excess returns on Fung and Hsieh (2004) seven factors. A management company's alpha is calculated as the equal-weight average alphas of the managed hedge funds (see detailed discussion in the last section). In Exhibit 1, the mean and median of alphas is 2.86% and 1.40%, respectively, suggesting that more than half of hedge funds have positive alpha and that the distribution of alphas is skewed to the right. The mean of the other company-level characteristics such as AUM, return, flow, age, and volatility are $0.50 billion, 3.85%, 24.42%, 43.47 months, 7.71%, respectively.

Prime Brokers and IPOs Allocation

In this section, we measure the role that prime brokers play in allocating IPOs to hedge funds. We then proceed to examine the determinants of IPO allocations by lead prime brokers to lead client funds.

Exhibit 1: Summary Statistics of IPO and Hedge Fund Data

The table presents summary the statistics of the IPO data in our sample. The source of IPOs are from SDC issue data matched with 13F institutional holding data and TASS hedge fund database from 1994 through 2012. We partition IPOs into hot versus cold IPOs using zero initial IPO return as a cutoff and report statistics for all samples, hot IPOs, and cold IPOs. The reported statistics in Panel A include the number of IPOs, offer price, shares offered, offer proceeds, initial IPO return, and pre-IPO demand. The reported statistics in Panel B are on the hedge fund management company level, including the number of prime brokers per management company, alpha, AUM, return, flow, age, and volatility. The definitions of the above variables are provided in the Appendix. The reported statistics include mean, standard deviation (std dev), min, median, and max.

Panel A: Summary statistics of IPO data

Number of IPOs	1,160
Number of lead underwriters	295

	All samples	Hot IPOs	Cold IPOs
Number of IPOs	1,160	927	233
Offer price			
Mean	16.68	16.78	15.94
Median	16.00	16.00	15.00
Shares offered (million)			
Mean	17.12	16.94	18.50
Median	7.80	7.50	10.00
Offer proceeds (million)			
Mean	301.68	303.82	285.64
Median	123.01	120.00	160.00
Initial IPO return (%)			
Mean	30.61	35.81	-8.18
Median	12.53	16.20	-4.00
Pre-IPO demand (%)			
Mean	12.68	13.67	-3.25
Median	5.00	5.55	-6.21

Panel B: Summary statistics of hedge fund data

Number of management companies	125
Number of hedge funds	767
Number of prime brokers	81

	Mean	Std Dev	Min	Median	Max
Number of prime brokers	3	2	1	3	11
Alpha (%)	2.86	9.55	-15.10	1.40	39.41
AUM ($ billion)	0.50	0.88	0.03	0.22	5.43
Return (% qtr)	3.85	4.76	-10.47	3.33	16.72
Flow (% qtr)	24.42	57.73	-25.53	6.62	321.18
Age (mon)	43.47	39.04	16.10	35.33	58.48
Volatility (% qtr)	7.71	12.97	2.43	4.00	53.70

The Propensity to Allocate IPOs to Lead Client Funds

The first question we address is whether lead client funds are more likely to receive an allocation from lead prime brokers. Following Binay, Gatchev, and Pirinsky (2007), we quantify the role of prime brokers by measuring the probability that a hedge fund is allocated an IPO conditional on its relationship with a prime broker who is the lead underwriter of that IPO. This probability is compared to the unconditional probability of receiving an IPO allocation from a lead underwriter. We use the term prime allocation propensity to refer to the difference between the above conditional and unconditional probabilities. We focus on lead underwriters because they are most important in making IPO allocation decisions.

For each IPO i in quarter t, we define the prime allocation propensity ($\Delta P_{i,t}$) as the difference between the probability that a hedge fund receives an allocation ($A_{i,t}$) of IPO i conditional on having a relationship with the lead underwriter ($R_{i,t}$) and the unconditional probability of receiving an allocation:[9]

$$\Delta P_{i,t} = P(A_{i,t}|R_{i,t}) - P(A_{i,t}), \tag{1}$$

where

$$P(\cdot|*) = \frac{\sum_{j=1}^{n^*_{i,t}} \text{HF-Investment}_{j,i,t}}{\sum_{i=1}^{N^*_t}\sum_{j=1}^{n^*_{i,t}} \text{HF-Investment}_{j,i,t}} \tag{2}$$

HF-Investment$_{j,i,t}$ is defined as the dollar value of IPO i allocation received by hedge fund management company j in quarter t, which is calculated as the offer price times the number of shares held by the management company.[10] $n^*_{i,t}$ and N^*_t are, respectively, the number of hedge fund management companies invested in IPO i in quarter t and the number of hedge fund management companies invested in all IPOs in quarter t, conditional (or unconditional) on that the management companies have prime brokerage relationships with the lead underwriter(s) of IPO i.

We calculate the conditional probability of IPO allocation to hedge funds, $P(\cdot|*)$, as the sum of hedge fund management companies' investments in quarter t in IPO i whose lead underwriter also provides prime brokerage services to the management companies, divided by the sum of management companies' investments in quarter t in all IPOs that are underwritten by the same lead underwriter. The unconditional probability is the investments in IPO i in quarter t by hedge fund management companies divided by the sum of management companies' investments in all IPOs in the same quarter. We exclude hedge funds that do not have any prime broker-lead underwriter relationship.

We further test whether lead client funds receive relatively larger amounts of IPOs underwritten by lead prime brokers. Exhibit 2 Panel A provides the statistical analysis results. The

[9] Instead of unconditional probability $P(A_{i,t})$, we also use conditional probability $P(A_{i,t}|\text{No Relationship})$ as the second term in measuring prime allocation propensity. We obtain similar results in unreported tests.

[10] We get similar empirical results when we use the number of IPOs held by hedge fund management company as $A_{i,t}$.

estimated prime allocation propensity captures the probability that an IPO is allocated to lead client funds relative to the probability that an IPO is allocated to any hedge fund. The average probability of IPO allocations to hedge funds conditional on their prime brokerage relationships with the lead underwriters of the IPOs is 37.42%, which is much higher than the average unconditional probability of IPO allocation, 13.58%. These results lead to a significantly positive prime allocation propensity of 23.84%, providing strong evidence of the favoritism of investment banks. That is, investment banks are more likely to favor their hedge fund clients when allocating IPOs where they are lead underwriters.

Next, we test whether lead client funds are more likely to receive allocations of hot IPOs than cold IPOs. Specifically, we evaluate the impact of IPO underpricing on the prime allocation propensity by examining the likelihood that lead client funds participate in IPOs with two different levels of underpricing. We partition IPOs into hot and cold based on their initial returns and estimate the conditional allocation, unconditional allocation, and prime allocation propensity for both pricing categories.

In Exhibit 2 Panel A, we report the statistical analysis for hot and cold IPOs, as well as aggregated statistics for all IPOs. The allocations for both pricing categories are much higher for lead client funds compared to other funds. The ΔP for hot IPO allocations to lead client funds (25.00%) is significantly higher than that for cold IPO allocations (16.41%). We test the differences in the two ΔPs for hot and cold IPOs. The p-value from this test strongly rejects the null that the propensities of allocating IPOs to lead client funds are the same for hot and cold IPOs. In conclusion, our analysis shows that lead client funds receive larger allocations of underpriced IPOs from their lead prime brokers compared to other funds.

To examine the impact of market conditions on prime allocation propensity, we plot the average prime allocation propensity each year from 1994 to 2012 in Exhibit 3. In order to control for the market impact on IPO issuance, we standardize the average prime allocation propensity by dividing it by the number of IPOs in a year.

The average prime allocation propensity is time-varying. The estimated propensity tends to increase sharply during bearish market periods, and then gradually decreases back to its long-term average as markets recover. For the post-internet bubble of 2000-2003, the standardized propensity increased by 40.15% as equity markets entered a bearish period, and reached the highest point of 42.66% in 2001. During the global financial crisis of 2008-2009, compared to other funds, lead client funds were about 37.19% more likely to receive IPO allocations from their lead prime brokers. Moreover, in 2008, the conditional probability that lead client funds would receive allocations of hot IPOs from their lead prime brokers was 20.52% higher than the conditional probability of receiving cold IPOs. These estimated differences are not observed during other periods when equity markets are performing relatively well.

In Exhibit 2 Panel B, we provide statistical analyses of changes in the propensity to allocate IPOs over time. We divide our sample into five subperiods, among which 2001-2003 and 2008-2009 are bearish periods, and the rests are bullish periods. Consistent with the above analyses, the average propensity to allocate IPOs in each subperiod is positive, with the highest value of 39.27%

Exhibit 2: Statistical Analysis of IPO Allocation to Lead Client Funds

This table presents the statistical analysis for the propensity of allocating IPOs to lead client funds based on our IPO samples from 1994 through 2012. We partition IPOs into hot and cold IPOs based on the zero initial return. The reported statistics include the conditional allocation, which is the probability that a hedge fund receives an allocation conditional on its prime broker-lead underwriter relationship, the unconditional allocation, which is the probability that a hedge fund receives an allocation from any lead underwriter, and the prime allocation propensity, which is defined as the difference between the conditional and unconditional allocation. Panel A reports the statistical analysis of prime allocation propensity for hot and cold IPOs, as well as aggregate data for all IPOs. Panel B reports the prime allocation propensity of 5 subperiods, among which 2001-2003 and 2008-2009 are bearish periods, and the rest time periods are bullish periods. The last column tests the significance of the differences in the means, with p-values in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

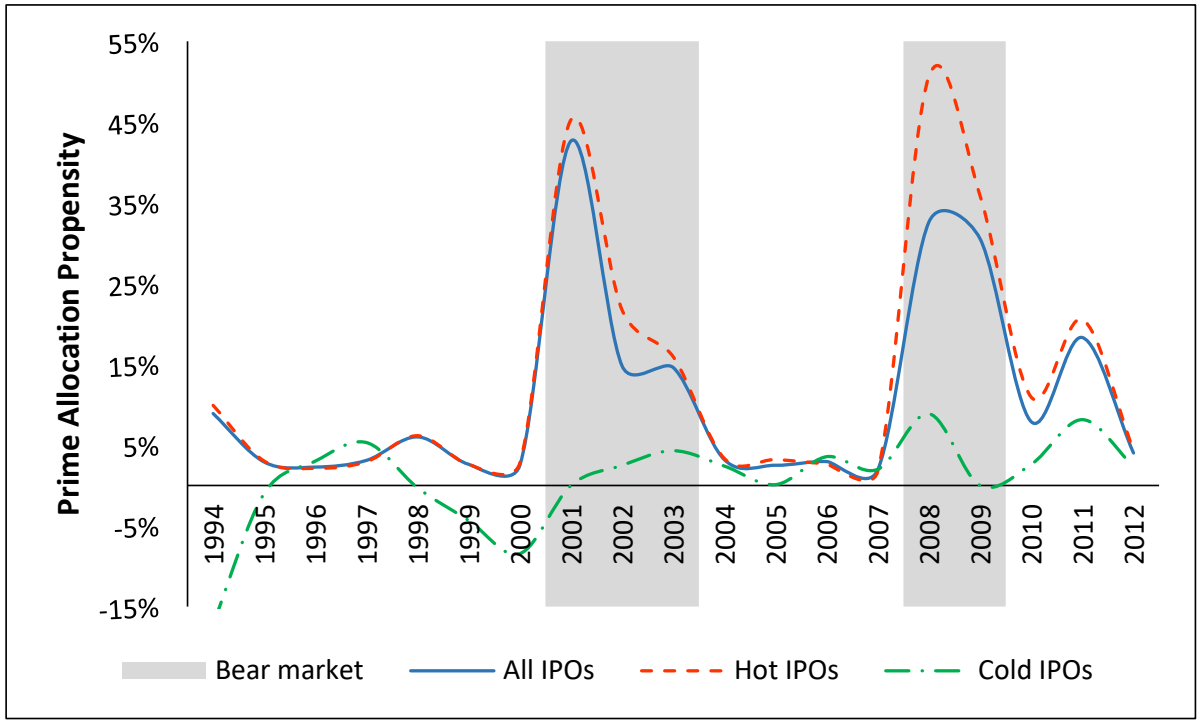
Panel A: IPOs allocation

	All IPOs	Hot IPOs	Cold IPOs	Test Equality
Conditional allocation				
Mean	37.42%	34.68%	55.02%	(<0.0001)***
Median	10.10%	8.36%	80.06	
Unconditional allocation				
Mean	13.58%	9.70%	38.61%	(<0.0001)***
Median	3.91%	3.31%	22.77%	
Prime allocation propensity (ΔP)				
Mean	23.84%	25.00%	16.41%	(0.0003)***
Median	3.10%	3.36%	2.62%	

Panel B: prime allocation propensity (ΔP) by periods

	All IPOs	Hot IPOs	Cold IPOs	Test Equality
1994-2000	23.85%	25.55%	-5.94%	(<0.0001)***
2001-2003	39.27%	46.13%	4.26%	(0.0001)***
2004-2007	21.75%	20.77%	26.02%	(0.1138)
2008-2009	37.19%	42.12%	21.60%	(0.050)**
2010-2012	19.16%	19.32%	18.74%	(0.9030)

Exhibit 3: The Evolution of Prime Allocation Propensity



This figure plots the standardized average prime allocation propensity of all IPOs, as well as hot and cold IPOs, to lead client funds each year from 1994 to 2012. The prime allocation propensity in the *y*-axis is defined as the difference between the probability that hedge funds get an allocation of IPO conditional on their prime broker-lead underwriter relationships and the unconditional allocation probability. We define issues with initial returns greater than zero as hot IPOs, and as cold IPOs otherwise. The sample period extends from 1994-2012, and the bear markets are from 2001 to 2003 and from 2008 to 2009.

in 2001-2003. Further, the propensity to allocate hot IPOs is significantly higher than that of cold IPOs in all bearish periods. However, it is not necessarily the case in bullish periods. In the bullish period of 2004-2007, the average propensity to allocate hot IPOs is economically lower than that of cold IPOs, suggesting that lead client funds may sometimes act as dumping grounds of IPO allocations for the benefit of their lead prime broker.[11]

A potential interpretation is that lead prime brokers are keener to help their clients during bear markets by giving them relatively larger allocations of underpriced IPOs. This support during bearish periods is likely to have a higher positive impact on the survivorship of the funds, their ability to raise funds when markets recover, and their preference to continue doing business with the same prime brokerages as markets recover. We test for prime broker turnover using yearly snapshots of the TASS database from 2006 to 2012. We do not find any significant turnover of prime brokers. Prime brokers benefit from hedge fund clients and, therefore, assist in hedge fund survivorship by providing their clients with underpriced IPOs, especially during hard times for their clients, i.e., during bear markets.

Determinants of The Prime Allocation Propensity

To further examine whether lead prime brokers favor their clients to a greater extent than other hedge funds, we perform a multivariate regression of the prime allocation propensity (ΔP) on several explanatory variables. Note that to simplify the notation, the superscript *i* is dropped.

$$\begin{aligned}\Delta P = \alpha &+ \beta_1 \textit{Initial IPO Return} + \beta_2 \textit{Pre-IPO Demand} + \beta_3 \textit{Log(Proceeds)} \\ &+ \beta_4 \textit{Log(HF Holdings)} + \beta_5 \textit{Past Relation} + \beta_6 \textit{Reputation} \\ &+ \beta_7 \textit{Lead UW Size} + \beta_8 \textit{High Tech} + \varepsilon \end{aligned} \tag{3}$$

Exhibit 4 reports the regression analysis results. The definitions of explanatory variables are: *Initial IPO Return* is the day-one return of the IPO, using the offer price and the first-day closing price. *Pre-IPO Demand* is measured as the percentage difference between the midpoint of the filing range and the offer price. *Log(Proceeds)* is the natural logarithm of the proceeds from the IPO using the offer price. *Log(HF Holdings)* is the natural logarithm of the average equity holdings of the hedge fund management companies in the last quarter. *Past Relation* is the probability of hedge funds' participation in an IPO conditional on their past IPO deals with the same lead underwriters, measured according to Binay, et al. (2007). *Reputation* is the lead underwriter's reputation ranking obtained from Jay Ritter's website, according to Loughran and Ritter (2004)[12]. *Lead UW Size* is the number of lead underwriters of the IPO. *High Tech* equals

[11] Mooney (2013) finds that IPOs purchased by affiliated mutual funds have lower mean initial returns than others, suggesting that investment banks allocated cold IPOs to affiliated mutual funds to preserve investment banking fee income at the expense of fund shareholders.

[12] Loughran and Ritter (2004) assign the rankings to underwriters on a 0-9 scale based on where they are listed in the underwriting section of the prospectus that a firm filed to the SEC. In a prospectus, lead underwriters are listed first, followed by co-managing underwriters, and then other syndicate members. More prestigious underwriters are listed first and assigned a higher ranking with the top ranking of 9. See https://site.warrington.ufl.edu/ritter/ipo-data/.

one if the IPO firm is in high-tech (Ljungqvist and Wilhelm 2003; Loughran and Ritter 2004), and zero otherwise. The results are reported separately for all samples, as well as for periods of rising and declining equity prices. We control for the timing of the IPOs by including time fixed effects for all models.

IPO underpricing and pre-market demand measures are highly correlated, but the offer price does not fully adjust to reflect a pre-market interest in the book-building process (Benveniste and Spindt 1989; Hanley 1993). We include *Initial IPO Return* and *Pre-IPO Demand* in our regression separately. The coefficients on these two variables in both models are positive and significant[13], suggesting that the hotter the issue, the higher the chance that lead prime brokers allocate the issue underwritten by them to their hedge fund clients.

Issue proceeds are considered as a proxy for the issue size (Aggarwal, et al. 2002). Given the positive and significant coefficients of *Log(Proceeds)* reported in Exhibit 4, lead prime brokers reward their clients by allocating issues of bigger firms to such clients. Since larger issues are more liquid, this allows lead client funds to liquidate their positions more quickly should they choose to book the gains realized from underpriced IPOs.

The coefficients on hedge funds' average equity holdings are negative and significant, indicating that fewer holdings are associated with the higher probability of allocating IPOs to relationship hedge funds. One possible interpretation might be that these hedge funds reduce their holdings, anticipating a large IPO allocation from their lead prime brokers. Also, this result is consistent with other results that hedge funds with smaller AUM tend to receive larger allocations of IPOs.

The regression coefficients on *Past Relation* in both models are positive and significant, suggesting that funds with a previous relationship with lead prime broker are more likely to be allocated current IPOs. The positive coefficient on *Lead UW Size* suggests that lead client funds have a higher chance of being allocated issues with multiple lead underwriters. This situation can arise because larger syndicates have wider access to hedge funds, and the IPO participation is consequently higher for their clients. The negative coefficients on *Reputation* in regressions of using pre-IPO demand as a regressor indicates that lead client funds are more likely to be allocated issues underwritten by investment banks that rank low on the reputation scale. We interpret this result as evidence that favoritism is especially helpful to less reputable underwriters for maintaining current relationships and attracting future businesses with hedge funds.

In addition, the regressions performed during bullish and bearish periods offer similar results as those from the regressions on total samples. The coefficients on *initial IPO return* are significantly positive for both periods but with the larger magnitude in the bearish period. Also, the negative coefficients on *HF Holdings* in model (5) have a larger magnitude in bearish periods than those in bullish periods. These results are consistent with our analysis in previous section that prime brokers tend to help their hedge fund clients survive tough times by providing them with underpriced IPOs.

[13]Due to the small sample size caused by the variable *Pre-IPO Demand*, all coefficients (except for the *Log(Proceeds)*) in bearish periods are insignificantly different from zero.

Exhibit 4: Regression Analysis of IPOs Allocation to Lead Client Funds

The table reports estimates of a multivariate regression for IPOs offered between 1994 and 2012. The dependent variable is the Prime Allocation Propensity (ΔP), defined as the difference between the probability that hedge funds get an allocation of IPO conditional on their prime broker-lead underwriter relationships and the unconditional allocation probability. Independent variables include the day one return of the IPO, measured as the percentage return from the offer price to the first-day closing price (*Initial IPO Return*), the percentage difference between the midpoint of the filing range and the offer price (*Pre-IPO Demand*), the natural logarithm of the IPO offer proceeds (*Log(Proceeds)*), the natural logarithm of the average equity holdings of the hedge fund management companies in the last quarter (*Log(HF Holdings)*), the average historical relationship participation for the lead underwriter's IPOs over the past five years (*Past Relation*), the lead underwriter reputation ranking based on Loughran and Ritter (2004) (*Reputation*), the number of lead underwriters of the IPO (*Lead UW Size*), and a high-tech and Internet IPO dummy variable (*HighTech*). The table reports the estimated coefficients from 1994-2012, among which 2001-2003 and 2008-2009 are bearish periods, and the remaining time periods are bullish periods. The t-values are reported in parentheses. The last three rows report the number of observations, the R-squared, and the F-test results of each regression. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent variable: Prime Allocation Propensity (ΔP)					
	All samples		Bullish periods		Bearish periods	
	(1)	(2)	(3)	(4)	(5)	(6)
Initial IPO return	4.706***		3.908**		6.732**	
	(3.37)		(2.46)		(2.19)	
Pre-IPO demand		3.644**		3.358**		1.013
		(2.59)		(2.34)		(0.01)
Proceeds (log)	7.103***	11.322***	8.057**	11.085***	4.447*	23.449**
	(9.44)	(9.60)	(10.18)	(9.09)	(1.81)	(2.38)
HF Holdings (log)	-4.053***	-4.446***	-3.600***	-5.521***	-5.008***	-4.388
	(-6.77)	(-3.23)	(-5.56)	(-4.23)	(-3.21)	(-0.65)
Past relation	0.484***	0.296**	0.510***	0.369***	0.452***	0.459
	(9.08)	(4.02)	(9.09)	(4.86)	(2.71)	(1.44)
Reputation	0.042	-0.836**	-0.021	-1.261***	-0.218	-0.001
	(0.33)	(-2.19)	(-0.15)	(-2.81)	(-0.65)	(-0.00)
Lead UW size	0.530***	0.273	0.343**	0.131	0.538	-10.427
	(3.25)	(1.11))	(2.07)	(0.52)	(0.41)	(-0.81)
High Tech	-2.408	1.736	-2.090	1.658	-1.959	-10.904
	(-1.39)	(0.55)	(-1.16)	(0.52)	(-0.37)	(-0.33)
Constant	41.780***	40.504	28.867**	63.548***	75.399**	-3.081
	(3.78)	(1.63)	(2.42)	(2.66)	(2.54)	(-0.01)
Observations	2,193	765	1,848	734	325	34
R-squared	0.1404	0.2274	0.1429	0.1937	0.1156	0.3157
F Statistic	51.73***	32.30***	49.93***	31.54***	4.32***	2.26*

Prime Brokers and Hedge Fund Investments in IPOs

In this section, we use hedge funds' characteristics to study the impact of lead client funds' characteristics on the size of IPO allocations received from lead prime brokers. We present a separate analysis of allocations of hot versus cold IPOs and examine the effect of fund skills on IPO investments.

Lead Client Funds and IPO Allocations

To examine the impact of lead client funds' characteristics on the IPOs allocation, we run a pooled regression of the relative size of the IPO allocations received by a management company, both lead, and non-lead client funds, on the characteristics of prime brokers and hedge funds. The regression has the following specification:

$$IA_{j,t} = \alpha + \beta_1 MultiPBs_{j,t} + \beta_2 BigPBs_{j,t} + \beta_3 HotIPOs_{j,t} + \beta_5 Controls_{j,t-1} + \varepsilon_{j,t} \qquad (4)$$

where $IA_{j,t}$ is IPO allocation received by a lead client fund or non-lead client fund measured as the percentage of AUM of management company j in quarter t, $MultiPBs_{j,t}$ is a dummy variable indicating whether the management company j has more than one prime broker in quarter t, $BigPBs_{j,t}$ is the percent of lead underwriters that are among the top ten largest banks and allocate IPOs to the management company j in quarter t, $HotIPOs_{j,t}$ is the number of hot IPOs participated in by the management company j in quarter t. $MultiPBs_{j,t}$, $BigPBs_{j,t}$, and $HotIPOs_{j,t}$ capture the closeness in the relationships between hedge funds and lead underwriters. The control variables include the management company's return, flow, log(age), and volatility.

Exhibit 5 reports the results from the above regression after adjusting standard errors for two-way clustering at the management company and quarter level. We include the three characteristic variables separately in the regression to avoid potential correlations. We find that a 1% increase in $MultiPBs_{j,t}$ is associated with 0.277% increase in IPO allocations received by lead client funds and 0.656% decrease in IPO allocations received by non-lead client funds. The difference between the two coefficients ($IA\ Diff$) is positive and significant. We interpret this result as evidence that, for lead client funds, using multiple prime brokers should contribute to more connections between hedge funds and lead underwriters, leading to a higher chance of getting IPO allocations from these relationships. This result is especially prevalent for IPO allocations received by non-lead client hedge funds since their chances of getting IPO allocations are smaller than those for lead client funds, as reported in the first section.

To further test the strength of the hedge fund-prime broker relationship, we examine the other two proxies for the strength of the relationship. Since large prime brokers receive the lion's share of hedge funds' business, we expect that they should reward their hedge fund clients by allocating more issues to them. Our test results support this conjecture. The coefficient on $BigPBs_{j,t}$ is 0.364 for lead client funds at 1% level of significance, suggesting that hedge funds tend to receive

more IPO allocations from big prime brokers. In addition, the positive coefficient on $HotIPOs_{j,t}$ suggests that lead client funds receive more IPO allocations when a large number of hot issues are allocated to the management company. These results indicate that prime brokerage business relationships facilitate hedge fund investments in IPOs, and a stronger relationship will lead to more profitable investment opportunities for lead client funds. Our test results strongly reject the null that the regression coefficients on $BigPBs_{j,t}$ or $HotIPOs_{j,t}$ are the same for lead and non-lead client funds.

The coefficients on the lagged return for lead client funds in three models are negative economically, suggesting that the lower lagged return is associated with the higher IPO allocations being received by lead client funds. In addition, the difference in the coefficients on lagged return between lead and non-lead client funds is significantly negative in the regression of using either $MultiPBs_{j,t}$ or $BigPBs_{j,t}$ as the independent variable. We interpret this as evidence that lead prime brokers are more inclined to help those clients that have shown poor performance in the past, increasing their chances of survival and growth. Prime brokers' roles do not appear to be limited to those of a traditional service provider. Still, they are extended to an essential supporter of the fund's ability to gain access to profitable opportunities not available to other funds.

Hot and Cold IPO Allocations to Hedge Funds

We have seen strong evidence that lead client funds receive larger allocation of underpriced IPOs. However, it is not clear whether the larger allocation is a result of active decisions by lead prime brokers to allocate underpriced IPOs to their favorite clients, or it is due to active decisions of hedge fund managers to invest in these IPOs. Because of lack of data, we cannot directly test the decision-making process of lead prime brokers and their clients. However, we can offer indirect evidence related to this question. In particular, if a hedge fund manager is skilled in identifying potentially underpriced IPOs, then we argue that the same skills should allow the manager to generate abnormal positive returns. With this goal in mind, we regress the relative size of a hedge fund management company's investments in hot and cold IPOs, on a variable indicating if the find is a client of lead prime brokers and an estimate of the management company's alpha. The regression has the following specification:

$$\begin{aligned} IA_{j,t} = \alpha + \beta_1 Relationship_{j,t} + \beta_2 Alpha_{j,t} + \beta_3 MultiPBs_{j,t} + \beta_4 BigPBs_{j,t} \\ + \beta_5 Controls_{j,t-1} + \varepsilon_{j,t} \end{aligned} \tag{5}$$

where $IA_{j,t}$ is hedge fund investments in hot (or, cold) IPOs measured by the percentage of AUM of management company j in quarter t, $Relationship_{j,t}$ is a dummy variable indicating whether more than half of the IPOs owned by lead client fund j in quarter t, $Alpha_{j,t}$ is the average alpha of funds in the management company j in quarter t. $MultiPBs_{j,t}$ and $BigPBs_{j,t}$ are defined in the previous section.

To estimate alpha, we adopt a rolling-window method to regress the net-of-fee monthly excess return (above the risk-free rate) of each hedge fund on the seven factors constructed by Fung

Exhibit 5: Regression Analysis of Hedge Fund IPO Investments

The table presents regression analysis of lead client fund and non-lead client fund investments in IPOs. The dependent variable is the $IA\ LCF_t$ or $IA\ NLCF_t$, which is calculated as the ratio of lead client fund (LCF) or non-lead client fund (NLCF) investments in IPOs to the hedge fund management company's asset under management. Independent variables include a dummy variable which is one if the management company has more than one prime brokers and zero otherwise ($MultiPBs_t$), the percent of lead underwriters that are among the top ten largest banks and allocate IPOs to the management company ($BigPBs_t$), the number of hot IPOs participated in by the management company ($HotIPOs_t$), the management company's return in quarter $t-1$ ($Return_{t-1}$), the net money flow of management company in quarter $t-1$ ($Flow_{t-1}$), the natural logarithm of the average age of the managed hedge funds in the management company at time $t-1$ ($LogAge_{t-1}$), and the average standard deviation of the previous year's returns of funds in a management company at time $t-1$ ($Volatility_{t-1}$). The table reports the estimated coefficients using pooled regression with standard errors clustered by management companies and quarters. The t-values are presented in parentheses. The last three rows report the number of observations, the R-squared, and the F-tests results of each regression. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent variable:								
	IA LCF	IA NLCF	IA Diff	IA LCF	IA NLCF	IA Diff	IA LCF	IA NLCF	IA Diff
	(1)	(2)	(1)-(2)	(3)	(4)	(3)-(4)	(5)	(6)	(5)-(6)
$MultiPBs_t$	0.277**	-0.656*	0.933**						
	(2.19)	(-1.71)	(2.55)						
$BigPBs_t$				0.364***	-0.842***	1.207***			
				(3.58)	(-2.84)	(3.78)			
$HOTIPOs_t$							0.793***	0.594***	0.768***
							(4.94)	(6.00)	(6.71)
$Return_{t-1}$	-1.507*	3.138**	-4.645***	-1.132	2.275	-3.408**	-1.194	-0.175	-0.009
	(-1.68)	(1.97)	(-3.14)	(-1.30)	(1.34)	(-1.97)	(-1.46)	(-0.13)	(-0.01)
$Flow_{t-1}$	0.287	-0.351	0.638	0.252	-0.272	0.524	0.259	-0.238	0.438
	(1.30)	(-1.49)	(1.62)	(1.22)	(-0.58)	(1.30)	(0.73)	(-0.50)	(1.28)
$LogAge_{t-1}$	-0.006	-0.268	0.261	0.011	-0.311*	0.323*	-0.002	-0.228	0.189
	(-0.08)	(-1.49)	(1.48)	(0.18)	(-1.73)	(1.80)	(-0.02)	(-1.15)	(1.14)
$Volatility_{t-1}$	0.259	0.440	-0.181	0.174	0.639	-0.464	0.178	0.827**	-0.728
	(0.94)	(1.39)	(-0.32)	(0.55)	(1.65)	(-0.67)	(0.88)	(2.12)	(-1.18)
Constant	0.332	2.863***	-2.531***	0.133	3.327***	-3.194***	0.164	1.788**	-1.283*
	(1.17)	(3.71)	(-3.21)	(0.53)	(3.93)	(-3.81)	(0.50)	(2.07)	(-1.70)
Observations	815	815	815	815	815	815	815	815	815
R-squared	0.0102	0.0377	0.0472	0.0183	0.0376	0.0473	0.1732	0.1456	0.1981
F Statistic	3.03**	7.19***	9.73***	4.13***	4.66***	6.68***	14.55***	25.65***	24.30***

and Hsieh (2004) (see Appendix). Following Naik, Ramadorai, and Stromqvist (2007), for each month, we calculate a funds' factor loadings on the seven factors using the previous 24 months of data, and obtain the risk-adjusted return as the hedge fund alpha. A management company's $Alpha_{j,t}$ is calculated as the equal-weight average of the alphas of the managed hedge funds in the company j in quarter t.

Exhibit 6 reports the regression results of hedge fund investments in hot and cold IPOs. A one percent increase in $Relationship_{j,t}$ is associated with 0.779% increase in *Hot IA* at 1% level of significance. The coefficient on $Relationship_{j,t}$ for *Cold IA* is negative, leading to the significantly positive difference ($IA\ Diff$) between the two coefficients. These results are consistent with the idea that investment banks engage in favoritism when allocating IPOs to investors.

We find that the coefficients on $Alpha_{j,t}$ are not significant for hedge fund investments in both hot and cold IPOs, suggesting that underpriced IPOs are "pushed" by lead prime brokers on their clients rather than being identified and "pulled" by lead client funds. This suggests that hedge fund managers are not responsible for identifying underpriced IPOs and then asking their prime brokers to provide them with increased allocations of those IPOs.

We also find that a one percent increase in $BigPBs_{j,t}$ is associated with 0.706% decrease in *Hot IA*, suggesting that using multiple larger prime brokers is associated with less hot IPO allocations. Hedge funds may attempt to reduce their operational and funding liquidity risks by establishing relationships with multiple prime brokers.[14] We show that as hedge funds diversify across multiple prime brokers, the importance of their relationships with their lead prime brokers is diluted and consequently, such hedge funds receive smaller allocations of hot IPOs. The dilution effect appears to be stronger if the lead prime brokers are relatively large. As a result, prime brokers (especially large ones) tend to favor their hedge fund clients who do not diversity among other brokers and instead have an exclusive relationship with them. The coefficients on $BigPBs_{j,t}$ for *Cold IA* are not significant.

The coefficient on the lagged age is significantly negative for *Hot IA* but is insignificant for *Cold IA*, suggesting that younger hedge funds are more likely to be allocated hot IPOs. We interpret these results as evidence of competition between investment banks. To attract more prime brokerage or other businesses, lead underwriters allocate more underpriced issues to their new clients, whereas assigning more overpriced issues to the older clients who have already had a stable business relationship with them. Also, by helping the younger clients, lead prime brokers are increasing their chances of survival, which will benefit themselves in the long-run. Moreover, through allocating hot IPOs to younger funds, lead prime brokers send signals to other start-up hedge funds that they could play an important role in ensuring their success. These findings are also consistent with Liang (1999) that younger funds outperform aged funds in average performance.

In the following analyses, we make sure we are clearly identifying manager skill. So far, our results are consistent with previous studies that calculate a fund's alpha and attribute it to the manager's skill (Brown and Goetzmann 1995; Berk, Binsbergen, and Miller 2020). However,

[14]See Citibank. 2010. "The Liquidity Crisis and Hedge Fund Industry." Citi Prime Finance Publications, New York.

Exhibit 6: Regression Analysis of Hedge Fund Investments in Hot and Cold IPOs

The table presents regression analysis of hedge fund investments in hot and cold IPOs at the management company level. The dependent variable is the $IA\ Hot_t$ (or, $IA\ Cold_t$), which is calculated as the ratio of hot (or, cold) IPO investments to the hedge fund management company's asset under management. Independent variables include a dummy variable which is one if more than half of the IPOs owned by lead client fund in the management company, and zero otherwise ($Relationship_t$), the average alpha of funds in the management company ($Alpha_t$), a dummy variable which is one if the management company has more than one prime broker and zero otherwise ($MultiPBs_t$), the percent of lead underwriters that are among the top ten largest banks and allocate IPOs to the management company ($BigPBs_t$), the number of hot IPOs participated in by the management company ($HotIPOs_t$), the hedge management company's return in quarter $t-1$ ($Return_{t-1}$), the net money flow of management company in quarter $t-1$ ($Flow_{t-1}$), the natural logarithm of the average age of the managed hedge funds in the management company at time $t-1$ ($LogAge_{t-1}$), and the average standard deviation of the previous year's returns of funds in a management company at time $t-1$ ($Volatility_{t-1}$). The table reports the estimated coefficients using pooled regression with standard errors clustered by management companies and quarters. The t-values are presented in parentheses. The last three rows report the number of observations, the R-squared, and the F-tests results of each regression. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent variable:		
	IA Hot	IA Cold	IA Diff
	(1)	(2)	(3)
Relationship$_t$	0.779***	-0.067	0.847***
	(2.81)	(-0.64)	(2.85)
Alpha$_t$	-0.471	-0.003	-0.647
	(-1.21)	(-0.02)	(-0.97)
MultiPBs$_t$	-0.474	0.016	-0.490
	(-1.05)	(0.15)	(-1.12)
BigPBs$_t$	-0.706*	0.073	-0.778**
	(-1.92)	(0.62)	(-2.12)
Return$_{t-1}$	1.852	-0.480	2.332
	(1.36)	(-1.04)	(1.64)
Flow$_{t-1}$	-0.157	0.022	-0.180
	(-0.89)	(0.23)	(-0.89)
LogAge$_{t-1}$	-0.348**	0.006	-0.355**
	(-2.07)	(0.10)	(-2.06)
Volatility$_{t-1}$	0.356	0.273	0.082
	(0.68)	(0.57)	(0.08)
Constant	3.490***	0.276	3.213***
	(4.17)	(1.18)	(3.72)
Observations	807	807	807
R-squared	0.0496	0.0024	0.0428
F Statistic	4.78***	0.39	3.95***

there is always some uncertainty if the estimated alpha is random and mostly due to luck, or if it is due to lack of power of a statistical test (Pástor and Stambaugh 2002; Kothari and Warner 2001). Therefore, to isolate a manager's skills, we take a different approach by focusing on a specific set of skills: identifying underpriced IPOs.

Specifically, we partition IPO investments by a hedge fund into two portfolios: those that are underwritten by the hedge fund's lead prime brokers (LPB) and those that are underwritten by non-lead prime brokers (NLPB). We limit our hedge fund samples to those with at least one IPO underwritten by LPBs. With this restriction, we control for manager's skill, as IPOs in the two portfolios are managed by the same hedge fund. We then compare the performance of the two portfolios. If a hedge fund is primarily responsible for identifying underpriced IPOs and investing in them, then the two portfolios should not differ in performance. On the other hand, if LPB is the primary reason for a lead client fund investing in underpriced IPOs, then the portfolio of IPOs underwritten by the fund's lead prime broker should perform better.

Exhibit 7 presents the results of IPO performance comparison between the LPB and NLPB groups. We sort IPOs into three terciles based on the initial IPO returns (R): (1) highly underpriced IPOs with $R > 20\%$, (2) moderately underpriced IPOs with $0 < R \leq 20\%$, and (3) overpriced IPOs with $R \leq 0\%$. The sample mean, t-statistics and mean differences are reported for each tercile. We find that the mean initial return of IPOs underwritten by hedge fund's LPB is 72.37%, which is significantly higher than the 58.92% mean initial return on IPOs underwritten by NLPB. The mean differences of initial IPO returns between the LPB and NLPB for moderately underpriced IPOs and overpriced IPOs are not statistically significant. Our results provide evidence that hedge fund-prime brokerage relationships motivate investment banks to allocate highly underpriced issues to their hedge fund clients, suggesting that manager's skill is not the primary reason for investing in underpriced IPOs.

Exhibit 7: Test on the Irrelevance of Fund Manager's Skill in IPO Investments

The table presents a test for the performance of hedge-fund-invested IPOs that are underwritten by the hedge fund's lead prime brokers (LPB) and by non-lead prime broker (NLPB). Among the IPOs invested by a hedge fund in our sample, at least one IPO is underwritten by the hedge fund' prime broker. IPOs are sorted into three terciles based on the initial IPO returns (R): (1) highly underpriced IPOs with $R > 20\%$, (2) moderately underpriced IPOs with $0 < R \leq 20\%$, and (3) overpriced IPOs with $R \leq 0\%$. The sample mean, t-values (in parenthesis) and mean difference are presented for the LPB and NLPB. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Mean initial IPO return			
	LPB (1)	NLPB (2)	Difference (1)-(2)	t-stat
Highly underpriced	72.37%	58.92%	13.45% ***	(2.72)
Moderately underpriced	8.36%	9.11%	-0.75%	(-1.64)
Overpriced	-8.01%	-9.99%	1.98%	(0.80)

Conclusions

This paper provides evidence that prime brokers reward their hedge fund clients through allocations of underpriced IPOs. The relative sizes of these allocations are affected by several factors. First, relatively larger allocations of underpriced IPOs occur during bear markets. Second, younger funds tend to receive relatively larger allocations of underpriced IPOs. Finally, funds with recent poor performance are also rewarded by prime brokers. This evidence suggests that prime brokers time their allocations of underpriced IPOs to help their clients that would benefit the most from those allocations. The relationship between hedge funds and prime brokers is symbiotic as the health and longevity of hedge funds insure continued business for prime brokers.

We provide additional evidence that allocations of underpriced IPOs are rewards for being a client and are not driven by the skills of hedge funds managers. Hedge funds that have stronger hedge fund-prime broker relationships tend to receive more allocations of IPOs. However, allocations of underpriced IPOs are smaller if hedge funds diversify across multiple large prime brokers. Clearly, a prime broker prefers to reward those funds that have an almost exclusive relationship with that prime broker.

Overall, our results suggest that prime brokers play a supportive role in hedge fund investments and growth in expectation of stable on-going business relationships with hedge funds.

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Appendix

EXHIBIT A1: Definitions of variables

Variable	Definition
IPO and underwriter characteristics	
Offer price	The price at which the issue is offered.
Shares offered	The shares offered in $ million.
Offer proceeds	The amount raised from the IPO in $ million.
Initial IPO Return	The day-one return of the IPO, using the offer price and the first-day closing price.
Pre-IPO Demand	The percentage difference between the midpoint of the filing range and the offer price.
High Tech	Equals one if the IPO firm is in high-tech (Ljungqvist and Wilhelm 2003; Loughran and Ritter 2004), and zero otherwise.
Lead UW Size	The number of lead underwriters of the IPO.
Reputation	The lead underwriter's reputation ranking obtained from Jay Ritter's website, according to Loughran and Ritter (2004).
Past Relation	The probability of hedge fund's participation in an IPO conditional on their past IPO deals with the same lead underwriters, measured according to Binay, et al. (2007).
Hedge fund characteristics	
AUM	The assets under management (or size) of a hedge fund management company, calculated as the average of AUM of all hedge funds managed by a management company at the quarter end.
Return	The quarterly rate of return of a hedge fund management company, calculated as percentage change of the net asset values of the management company between the beginning and the end of a quarter.
Flow	The quarterly flow of a hedge fund management company, calculated as the percentage change of AUMs of a fund company over a quarter adjusted for return.
Age	The age of a hedge fund management company, calculated as the equal-weighted average age of the managed hedge funds.
Volatility	The estimated standard deviation of monthly returns of a hedge fund management company, calculated as the average of standard deviations of the managed hedge funds at the quarter end.
HF holdings	The average equity holdings of the hedge fund management companies in the last quarter.
Alpha	The estimated alpha of a hedge fund management company, calculated by first regressing monthly excess returns of the managed hedge funds on Fung and Hsieh seven factors to obtain the funds' alphas and then taking the average of these alphas at the quarter end.
MultiPBs	Equals one if a hedge fund management company has more than one prime broker, and zero otherwise.
BigPBs	The percent of lead underwriters that are among the top ten largest banks and allocate IPOs to the hedge fund management company at the quarter end.
HotIPOs	The number of hot IPOs participated in by the hedge fund management company at the quarter end.
Fung and Hsieh seven hedge fund factors	
FH1	The return of bond primitive trend-following strategy.
FH2	The return of currency primitive trend following strategy.
FH3	The return of commodity primitive trend-following strategy.
FH4	The Standard & Poors 500 monthly return minus risk free rate.
FH5	Russell 2000 index monthly total return minus Standard & Poors 500 monthly total return.
FH6	The monthly change in the 10-year treasury constant maturity yield.
FH7	The monthly change in the Moody's Baa yield less 10-year treasury constant maturity yield.

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