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Prime (information) brokerage ☆

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ABSTRACT

We show that hedge funds gain an information advantage from their prime broker banks regarding the banks' corporate borrowers. The connected hedge funds make abnormally large trades in the stocks of borrowing firms prior to loan announcements, and these trades outperform other trades. The outperformance is particularly strong for trades of hedge funds that have high revenue potential for prime broker banks. These informed trades appear to be based on information not just about the loan itself but also about firms' fundamentals such as future earnings. Finally, we find evidence suggesting that equity analysts inside the banks are one potential conduit of information transfer.

1. Introduction

Prime brokers are central to the operation of most hedge funds. In addition to execution and custody services, prime brokers provide financing to hedge funds for their leveraged positions and help facilitate short positions. In return, investment banks receive a substantial amount of revenue from hedge funds that use their prime brokerage

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services.[1] While the importance of the traditional services that prime brokers provide their hedge fund clients is well-understood (e.g., Aragon and Strahan, 2012), this study investigates a potential new benefit that hedge funds gain from their prime broker banks: an information advantage regarding the banks' corporate clients.

Investment banks often receive private information regarding their corporate clients as part of their advisory and origination activities. At the same time, banks have close relationships with their prime brokerage hedge fund clients. We hypothesize that information-hungry hedge funds gain an information edge regarding their bank's corporate clients from their connections to the prime broker bank. Investment banks often grant hedge fund clients that generate substantial revenue special access to broader resources and services of the bank (e.g., Lux, 2002). For instance, prized hedge fund clients get preferential access to in-house equity research analysts, key banking personnel, and exclusive meetings hosted by the banks (e.g., Enrich and Cimilluca, 2011; Morgenson, 2012). We conjecture access to these sources allows funds to obtain information regarding banks' corporate clients that is valuable either on its own or when combined with other information the funds already possess.

We test this hypothesis using the setting of bank loan originations to corporate clients. A large literature in banking argues that banks obtain access to nonpublic information concerning the borrower as part of the due diligence process (e.g., Fama, 1985; James, 1987; Rajan, 1992; Sufi, 2007). If hedge funds do gain an information edge due to their connections to prime broker banks, we would expect hedge funds to make informed trades in the shares of firms that borrow from the funds' prime broker banks. To test this idea, we combine data on hedge fund prime broker banks, loan originations, and hedge fund firms' 13F stock holdings from 1994 to 2014.[2] Using the merged data set, we examine whether hedge funds make larger, more profitable trades in the stocks of firms to which their prime broker banks originate loans. We refer to the stocks of firms that receive a bank loan in a given quarter as treated stocks in that quarter and the hedge funds whose prime broker bank is the lead arranger of the loan as connected hedge funds. We investigate whether hedge funds gain an information advantage by comparing connected funds' trades (i.e., quarterly holding changes) in treated stocks to other trades in our sample prior to loan announcement.[3]

To control for unobserved fund company or stock characteristics that could systematically vary between connected and unconnected funds or between treated and untreated stocks, respectively, we include both fund company × quarter and stock × quarter fixed effects in our empirical specification. This specification simultaneously explores (i) across-stock variations within each hedge fund portfolio and (ii) across-fund variation within each stock event. Controlling for time-variant fund company and stock characteristics eliminates the following two concerns at the same time: (i) value-relevant nonpublic information about the treated loan stock can reach both connected and nonconnected hedge funds through other channels; (ii) connected hedge funds might simply be more skilled and thus make informed trades in both treated and untreated stocks. In short, these fixed effects allow us to control for a variety of confounding factors and rule out alternative explanations such as connected hedge funds making informed trades in treated stocks for reasons unrelated to their connections to prime broker banks.

Our results support the hypothesis that hedge funds gain an information advantage from their prime broker banks. First, we find that connected hedge funds make abnormally large trades in treated stocks prior to the loan announcement date. We measure trade size using the absolute value of holding changes in the quarter prior to the loan announcement, scaled by the fund's assets under management (AUM). Our result shows that the absolute value of portfolio weight changes in treated stocks by connected hedge funds is 5.8 basis points (bps) higher than the control groups. This finding is economically significant given that the mean and median of absolute portfolio weight changes for all positions in our sample are 31.7 bps and 6.3 bps, respectively.

More importantly, we find that connected hedge funds perform better in their trades of treated stocks compared to the control groups. We measure the return that a fund earns in a trade by multiplying the portfolio weight change in the quarter prior to the loan announcement with the abnormal stock return in the subsequent quarter (i.e., the loan announcement quarter). We calculate abnormal stock returns using both Carhart (1997) four-factor alphas and Daniel et al. (1997) (henceforth, DGTW) characteristic-adjusted returns. Our results show that the contribution of a trade in a treated stock to the connected fund's quarterly abnormal performance is 0.24 bps to 0.29 bps higher compared to other trades. This effect is economically significant, as its magnitude is three to four times as large as the sample average of 0.07 bps per trade. Given that the average connected fund company holds about six treated stocks in a given quarter, these estimates suggest that an average connected fund company generates additional abnormal profits of $401,600–$479,000 per quarter from their trades of treated stocks compared to other trades. Furthermore, we show that a long-short portfolio that buys

[1] According to an estimate by Institutional Investor, hedge funds generate more than $10 million in annual investment banking revenue for every billion dollars that the funds have under management (Lux, 2002). In addition, an article by Forbes reports prime brokerage services revenue accounts for about 35% of total equities trading revenues of investment banks (Trefis Team. 2015. "Improving prime brokerage market share should lift profits at Goldman, Morgan Stanley." Forbes, October 7). Another article published in Bloomberg News reports that hedge funds were paying an estimated total of $25 billion in fees to investment banks in 2004, which represents more than one in every eight dollars of investment bank revenue (Lynn, 2005).

[2] We only observe portfolio holdings at the hedge fund company level. Thus, we use "hedge fund" and "hedge fund company" interchangeably in the context of portfolio holdings.

[3] We use "trade" and "holding changes" interchangeably, as we use 13F quarterly holdings changes to measure a trade in a given stock.

the loan stocks connected funds bought and sells the loan stocks that connected funds sold significantly outperforms a similar long-short portfolio that mimics the trades in the control group, with the difference in performance amounting to 1.34%−1.39% per month.

We carry out several tests to check the robustness of our baseline results and make three findings. First, we find no reversal in the outperformance of connected funds' trades in treated stocks, which suggests that the outperformance is not driven by temporary price pressure but rather due to an informational advantage regarding the treated stock. Second, we find no evidence that the hedge funds whose prime broker banks are mere participants in a loan (i.e., not a lead arranger) gain an information edge about the borrowing firm, which is consistent with the unique role of lead banks in the loan origination process (e.g., Sufi, 2007; Ivashina, 2009). Third, we find that the information advantage connected hedge funds have is stronger for a new lending relationship between the prime broker bank and the borrower, compared to an existing relationship. This evidence is consistent with the idea that banks are more likely to uncover new information when lending to a borrower for the first time (e.g., Peterson and Rajan, 1994).

Next, we conduct three additional tests to investigate the scenarios under which the information advantage is more pronounced. First, we test whether the information edge that connected funds have is increasing in their revenue generation potential to prime broker banks, as measured by (i) AUM in long-short equity strategies and by (ii) use of leverage financing.[4] Our results show that connected funds with greater revenue potential earn significantly higher returns in treated stocks compared to other connected funds. Second, we find that hedge funds that previously engaged in misconduct or violations of regulations (as reported in Form ADV) gain a larger information edge from their prime broker connections than other hedge funds. Third, we test whether the information edge of connected hedge funds increases in the information asymmetry of the borrowing firm. We use credit ratings and number of lead arrangers as proxies for information asymmetry and find that the connected hedge funds' outperformance is particularly strong when borrowing firms are more opaque.

Finally, we carry out several tests to investigate the information content and potential channels of information transfer. First, we find that connected funds' outperformance is present both over the three-day window around loan announcement and over the remaining of the loan announcement quarter, which suggests that the information edge connected funds possess is not only about the loan itself but also about the borrowing firm in general. Second, we find that connected funds' outperformance is particularly strong when the borrowing firm has (i) a large earnings surprise or (ii) a high intensity of 8-K filings during the loan announcement quarter, suggesting that the information edge is partly related to future earnings and the information contained in 8-K filings.[5] Last, we analyze one potential channel of information transmission: equity research analysts inside the lead bank who have been shown to possess nonpublic information about the borrowing firm (e.g., Chen and Martin, 2011). We find connected funds enjoy a larger information advantage when their prime broker bank also has an analyst covering the borrowing firm. Our finding suggests that analysts inside the bank are one potential channel of information transfer.

Taken together, our evidence suggests that hedge funds obtain an information advantage from their connections to prime broker banks. The special relationship with the banks helps funds obtain "nuggets" of information that are valuable either by themselves or when combined with other information signals these funds possess. One interpretation of our results is that hedge funds obtain valuable nonpublic information about their banks' corporate borrowers. This interpretation is in line with prior studies that show private information could flow from the corporate loan desk to other affiliated groups of investment banks (e.g., Acharya and Johnson, 2007; Massa and Rehman, 2008; Chen and Martin, 2011). While these studies show information flow from one unit to another within the institution, our study suggests that information flows from the bank to external parties (i.e., its hedge fund clients). Such information transfer raises concerns about insider trading and a breach of Chinese walls.[6] Another possible interpretation of our results is that the information shared is nonmaterial on its own but becomes valuable once combined with other information signals that the connected hedge funds have. This explanation is consistent with the evidence in the literature that hedge funds are better at processing information (e.g., Solomon and Soltes, 2015). Regardless of how connected hedge funds gain an edge, our results suggest that prime broker banks provide a valuable function of "information brokerage" to hedge fund clients.

Our paper also contributes to the nascent literature on hedge funds' prime brokers. A number of studies in this literature show that prime broker distress can cause contagion among hedge funds sharing the same broker

[4] Because prime brokers generate revenue through (i) commissions by executing trades and (ii) fees from providing financing for leveraged positions and facilitating short positions, hedge funds that primarily trade in equities and those that use leverage and take short positions have particularly high revenue potential. A report on prime brokerage by Barclays Capital Solutions Group in June 2015, titled "More with less: impact of regulations on the hedge fund financing model," notes that long-short equity funds are one of the most valuable types for prime brokerage revenues.

[5] The finding on earnings surprises is consistent with the fact that lead arrangers of a loan typically receive during due diligence nonpublic financial projections such as forecasted earnings from the borrowing firm.

[6] Although Chinese walls are set up to prevent such information transfers, it is not clear how effective they have been in practice. In addition to the evidence in the academic literature, the US Securities and Exchange Commission (SEC) also notes that these information barriers could be inadequate. In September 2012, the SEC published "Staff summary report on examinations of information barriers: broker-dealer practices under Section 15(g) of the Securities Exchange Act of 1934." The report notes that controls to prevent misuse of material nonpublic information (MNPI) were not often adequate. For example, the report states, "the apparent absence of related monitoring or other controls raises serious concerns about the ability of broker-dealers to guard adequately against misuse of MNPI in firm and customer trading."

(e.g., Klaus and Rzepkowski, 2009; Boyson et al., 2010; Aragon and Strahan, 2012). We add to this literature by uncovering a function of information brokerage that prime broker banks provide to hedge fund clients.[7] In this regard, our study is related to Chung and Kang (2016), who show comovement in the returns of hedge funds sharing the same prime broker. While their evidence is consistent with prime broker banks sharing information with hedge fund clients, their setting does not allow them to directly examine whether and what information prime broker banks share with their hedge fund clients. Our study does this by using detailed fund-holdings-level data combined with corporate events when such information sharing is possible and by controlling for unobservable factors using two sets of high-dimensional fixed effects.

Finally, our study adds to the literature on hedge fund performance.[8] Our paper suggests that hedge funds' connections to their prime broker banks represent an important source of alpha. More specifically, our paper adds to the literature showing that hedge funds trade on nonpublic information. Ivashina and Sun (2011) and Massoud et al. (2011) show that hedge funds that directly invest in syndicated loans make informed trades in the equity of the borrowing firm. Our paper differs from these two studies, as we find that funds that do not directly participate in the loans also trade on private information about borrowing firms that funds derive from their connections to prime broker banks. In addition, Qian and Zhong (2018) find that hedge funds earn abnormal returns in stocks after their initial public offering (IPO), especially when their prime brokers serve as the IPO underwriters. Share allocation in IPOs plays a critical role in their setting and could potentially be driving their main results. Our setting avoids this pitfall and allows for a cleaner test of any information advantage hedge funds have because of their connections to prime broker banks.

The remainder of this paper proceeds as follows. Section 2 describes data and variable construction. Section 3 discusses the design of our empirical analyses. Section 4 presents the empirical results on trade size and performance of hedge funds and provides a discussion of the results. Section 5 sets forth our conclusions.

2. Data and variable construction

2.1. Data

We combine a number of data sets for our analysis. First, information on hedge funds and their prime brokers comes from Mullally (2016), who combines four commercial hedge fund databases (the "union" database) based on the algorithm of Joenväärä et al. (2014). Specifically, the union database combines the Trading Advisor Selection System (TASS), Hedge Fund Research (HFR), EurekaHedge, and Morningstar hedge fund databases. The union database contains information on hedge funds' returns, AUM, contractual features, and service providers. The information on funds' service providers includes the name of each fund's prime broker(s). To mitigate concerns about survivorship bias in the commercial hedge fund databases, we only use data from 1994 through 2014.

Jorion and Schwarz (2014) show that hedge funds often report to multiple databases and begin doing so at different points in time. We take advantage of these strategic listing decisions to create a time series of hedge fund—prime broker observations. Specifically, for each hedge fund in the union database, we assume that the first broker a fund reports to any commercial database was the fund's broker since its inception. If the fund subsequently begins reporting to another database and lists a different prime broker, we update that fund's broker accordingly and fill in the broker data until the fund reports to another database or until the sample period ends in 2014.[9] We employ this algorithm for each fund in the union database and then aggregate the funds' brokers at the fund company level to create a list of brokers that each fund company uses in each month.

Next, we obtain stock holdings data from three sources. First, we use the Thomson Reuters 13F Institutional Holdings data to obtain information on stock holdings at the hedge fund company level. Institutions that hold at least $100 million in Section 13(f) securities are required to disclose their institution-level holdings on a quarterly basis.[10] However, as noted by Ben-David et al. (2016), the Thomson Reuters 13F database suffers from several data quality issues such as stale and omitted institutional reports and excluded securities after June 2013. To mitigate these concerns, we use a second source of holdings data from June 2013 onward: the 13F filing data directly obtained from the SEC's EDGAR website and made available to researchers via the Wharton Research Data Services (WRDS) platform. We obtain data on stock prices and returns from the Center for Research in Security Prices (CRSP).

We obtain information about corporate loans from Loan Pricing Corporation's (LPC) Dealscan database. This

[7] Our focus is on prime broker banks that provide a variety of prime brokerage services (e.g., leverage, security lending, custody and centralized clearing, trade execution, etc.) to hedge fund clients, whereas prior studies focus on the trade execution services brokerage houses provide to all of their institutional clients. For instance, Griffin et al. (2012) find little evidence of informed trading by the average brokerage house client of investment banks. Di Maggio et al. (2019) find that, after large informed trades, a significantly higher volume of other institutional investors execute similar trades through the same broker.

[8] The literature that analyzes informed trading by hedge funds includes, among others, Brunnermeier and Nagel (2004); Aragon and Martin (2012); Agarwal et al. (2013); Klein and Li (2015); Gao and Huang (2016); Gargano et al. (2017). There is also a large literature that studies hedge funds' ability to generate positive alpha (e.g., Brown et al., 1999; Agarwal and Naik, 2000; Kosowski et al., 2007; Aggarwal and Jorion, 2010; Jagannathan et al., 2010; Sun et al., 2012).

[9] One may be concerned that hedge funds change brokers over time and our methodology would not detect these changes. However, Chung and Kang (2016) examine snapshots of the TASS database and note that only 6.86% of TASS funds ever report changing their prime broker during their sample period.

[10] Section 13(f) securities are primarily US exchange-traded stocks (e.g., NYSE, Amex, and Nasdaq). See the following link for more information on 13F filings: https://www.sec.gov/divisions/investment/13ffaq.htm.

database contains detailed information about bank loans made to US and foreign corporations, with coverage starting from around the mid-1980s. Chava and Roberts (2008) report that Dealscan coverage is comprehensive from 1995 onward. We use the Compustat-Dealscan link made publicly available by Michael Roberts (see Chava and Roberts, 2008) to link this database with Compustat. We account for mergers and acquisitions when linking each lending entity to its parent bank. We then manually name-match each lender in the Dealscan data to our list of prime brokers. In our main analysis, we focus on hedge funds' connections to the lead arrangers since it is the job of the lead arranger to conduct due diligence on the borrower and process information (e.g., Sufi, 2007; Ivashina, 2009).

Prior studies have shown that some hedge funds directly invest in loans to obtain private information about the borrowing firm, especially during loan renegotiations (e.g., Ivashina and Sun, 2011; Massoud et al., 2011). We manually compare our list of hedge funds to the list of lenders in Dealscan to identify instances in which a hedge fund also participates in a given loan. To ensure that hedge funds' direct investment into loans does not drive our results, we exclude hedge fund companies that have ever co-invested in a syndicated loan. In addition, we also remove hedge fund firms that are affiliated with financial institutions in the Dealscan list of lenders. Last, we eliminate all loans to borrowers that do not have common stocks in the CRSP database.

We construct our merged data set as follows. First, we merge the Dealscan data to the union hedge fund database by manually matching the prime broker names in the union database to the lead lenders in Dealscan. This generates a mapping from each loan event to a set of hedge funds that are "connected" to the loan through their prime broker(s). The unit of observation in this merged data set is a fund-loan combination where each loan is denoted by a stock-quarter pair. Second, we eliminate fund-loan observations where the loan is made to companies before a hedge fund's inception date or after a fund died. Next, we manually match hedge fund companies in the union database to those in the 13F database and obtain their quarterly stock holdings. We only retain 13F institutions that are classified as pure-play hedge funds firms, as defined in Agarwal et al. (2013). Since we are concerned about trading on firm fundamental information, we also exclude hedge fund firms that are "quantitative" in nature, as these firms are unlikely to use ad hoc information from outside analysts in making trading decisions.[11] Finally, we focus our analysis on common stock holdings of fund companies and drop any fund quarters in which the fund company held fewer than ten stocks.

After the above procedures, our final sample contains 449 hedge fund companies and their quarterly holdings from 11,619 distinct fund-quarters from 1994Q1 to 2014Q4. These companies use 70 different prime brokers and hold the stocks of companies that received 8908 distinct loans. Forty-three out of the 70 brokers in our sample are associated with a bank that made at least one loan during our sample period. In 5743 out of the 11,619 distinct fund-quarters in our sample, hedge funds hold the stock of at least one firm to whom their prime broker bank originates a loan as lead arranger.

2.2. Summary statistics

We report summary statistics in Table 1. Panel A contains the statistics for the fund company variables, aggregated at the quarterly horizon. The average (median) fund company holds 132 (60) stocks. Across all fund-quarters in our sample, on average, fund companies hold the stocks of 2.8 firms that received loans from the fund company's prime broker bank that served as the lead arranger of the loan (connected loan stocks) and stocks of 14.5 firms that received loans with the lead arranger being other banks (nonconnected loan stocks). However, for quarters in which the fund company holds the stock of at least one firm to whom its broker makes a loan as the lead arranger, funds hold an average (median) of 5.8 (2) connected loan stocks. The mean (median) hedge fund company in our sample holds \$1,779 (\$410) million in long equity positions.

Panel B contains the statistics on the stock position level variables. The average (median) absolute quarterly position change, scaled by the hedge fund company's AUM, in our sample is 0.32% (0.06%). We use two measures of abnormal stock return in our analysis. The first measure, *Four-factor alpha*, is calculated using the Carhart (1997) model, which includes the Fama and French (1993) market, size, and value factors plus the momentum factor (Jegadeesh and Titman, 1993). We first estimate the betas for each stock in a quarter using the past year's daily stock returns. We then calculate the quarterly *Four-factor alpha* as the stock's cumulative return for a given quarter minus the sum product of its factor exposures times the factors' cumulative returns. Our second return measure is *DGTW*, which we compute as the difference between the stock's cumulative monthly return and that of its characteristic-based portfolio as in Daniel et al. (1997). For an average (median) position, the quarterly *Four-factor alpha* is −0.11% (−0.52%) and the quarterly *DGTW* is 0.00% (−0.57%).

Our trade profitability measures are equal to the product of the fund's change in ownership, scaled by AUM in a calendar quarter and the stock's abnormal return in the subsequent quarter (i.e., $\Delta Ownership_{i,j,t} \times Return_{j,t+1}$; fund i's change in ownership of stock j in quarter t multiplied by stock j's abnormal return in the following quarter). Fig. 1 provides a timeline to illustrate the calculation of our trade profitability measures. For example, if a fund reduces its holding for a stock in a quarter by 1% of AUM and the abnormal return measure for the stock in the subsequent quarter is −3%, the trade profitability measure is 0.03%, or 3 bps (= −1% × −3%). These measures can be interpreted as the incremental contribution to the fund company's quarterly abnormal return from the trade in a given stock. The average values of our two trade return

[11] We use information from an industry directory (StreetofWalls.com) as well as web searches to identify quant hedge fund firms. Our list includes prominent quant hedge fund firms such as D. E. Shaw, Two Sigma, Renaissance Technologies, and AQR Capital. Our results are not sensitive to including the quant funds in our main analysis.

Table 1
Summary statistics.
Panel A of this table reports summary statistics for the hedge fund company variables we use in our analysis. We report the statistics of these variables, which are tabulated at the fund company-quarter level. Panel B contains summary statistics for the stock-holding variables used in our analysis. The statistics for these variables are tabulated at the individual holding level (i.e., fund company-quarter-stock level). |Δ*Ownership*| is the absolute quarterly position change in a given stock, scaled by a fund company's AUM. *Loan* is an indicator variable equal to one if the hedge fund company's prime broker initiates a loan as a lead arranger on the stock in the following quarter, and zero otherwise. *Four-factor alpha* is calculated using the Carhart (1997) model. We first estimate the betas for each stock in a quarter using the past year's daily stock returns and then calculate the quarterly *Four-factor alpha* as the fund's cumulative return for a given quarter minus the sum product of its factor exposures times the factors' cumulative returns. *DGTW* is calculated as the difference between the stock's cumulative monthly return in a given quarter and that of its characteristic-based portfolio, as in Daniel et al. (1997). *Alpha* × Δ*Ownership* and *DGTW* × Δ*Ownership* are trade profitability measures; as shown in Fig. 1, they are calculated as the product of the fund's ownership change in a stock (Δ*Ownership*) in a calendar quarter and the next-quarter stock abnormal return (*Four-factor alpha* or *DGTW*). *Analyst* is an indicator variable for analyst coverage from the fund's prime broker bank. All variables in Panels A and B are winsorized at the 1% and 99% levels. Panel C presents summary statistics for the characteristics of the 8908 unique loans used in our analysis.

Panel A. Fund company variables

				Distribution	
	N	Mean	Std. dev	10th	50th	90th
# Stocks held	11,619	131.69	216.57	17.00	60.00	306.00
# Connected loan stocks held	11,619	2.76	6.40	0.00	0.00	7.00
# Nonconnected loan stocks held	11,619	14.51	22.11	1.00	6.00	38.00
# Prime brokers	11,619	1.96	1.22	1.00	2.00	4.00
Fund company AUM (in $ mill.)	11,619	1,778.95	7,445.41	84.51	410.05	2,875.32

Panel B. Stock-holding characteristics

				Distribution	
	N	Mean	Std. dev	10th	50th	90th
|ΔOwnership| (scaled by AUM)	1,813,550	0.317%	0.674%	0.001%	0.063%	0.881%
ΔOwnership (scaled by AUM)	1,813,550	0.014%	0.656%	−0.369%	0.000%	0.404%
Ownership (scaled by AUM)	1,813,550	0.485%	1.442%	0.000%	0.053%	1.297%
Loan	1,813,550	0.017	0.129	0.000	0.000	0.000
Quarterly four-factor alpha	1,813,550	−0.11%	19.20%	−22.19%	−0.52%	21.43%
Quarterly DGTW	1,811,510	0.00%	18.66%	−21.48%	−0.57%	21.31%
Alpha × ΔOwnership (basis points)	1,813,550	0.067	8.936	−3.852	0.000	3.993
DGTW × ΔOwnership (basis points)	1,811,510	0.071	8.713	−3.761	0.000	3.919
Analyst coverage at bank (0/1)	1,813,550	0.104	0.305	0.000	0.000	1.000

Panel C. Loan characteristics

				Distribution	
	N	Mean	Std. dev	10th	50th	90th
Size of loan ($ million)	8,895	1,103.85	2,011.34	111.20	500.00	2,500.00
# Members of syndicate	8,908	10.79	9.96	2.00	8.00	22.00
# Leads	8,908	2.27	1.80	1.00	2.00	4.00
# Facilities per loan	8,908	1.48	0.95	1.00	1.00	2.00

measures, *Alpha* × Δ*Ownership* and *DGTW* × Δ*Ownership*, are 0.067 bps and 0.071 bps, respectively.

Finally, we report the statistics on the loan variables in Panel C. The average (median) loan in our sample has a principal amount of $1,104 ($500) million, has 10.8 (8) members in the syndicate, has 2.3 (2) lead arrangers, and has 1.5 (1) facilities.

3. Empirical design

The objective of our empirical analysis is to investigate whether hedge funds gain an information edge from their relationships with prime broker banks that possess nonpublic information about corporate clients. To examine this question, we use the setting of loan originations by banks to corporate borrowers. Banks expend considerable resources to perform due diligence and screen firms before granting loans. For a small portion of loans for which information on mandate date is available, we find that the median time between the day a bank receives the mandate for a loan and the day the loan is closed is 75 days.[12] As argued by both academics and practitioners, banks obtain nonpublic information about borrowing firms during the loan origination process (e.g., Fama, 1985; James, 1987; Rajan, 1992; Sufi, 2007; Taylor and Sansone, 2007; Demiroglu and James, 2010). Thus, the event of loan origination, during which the lead bank collects nonpublic information about the borrower, provides a unique setting to investigate whether hedge funds gain an information advantage from their connections to prime broker banks.

If hedge funds are indeed gaining an information advantage from their connections to prime broker banks,

[12] Similar to prior work (e.g., Murfin and Petersen, 2016), we obtain information about mandate date from the Facility Dates file in the Dealscan database.

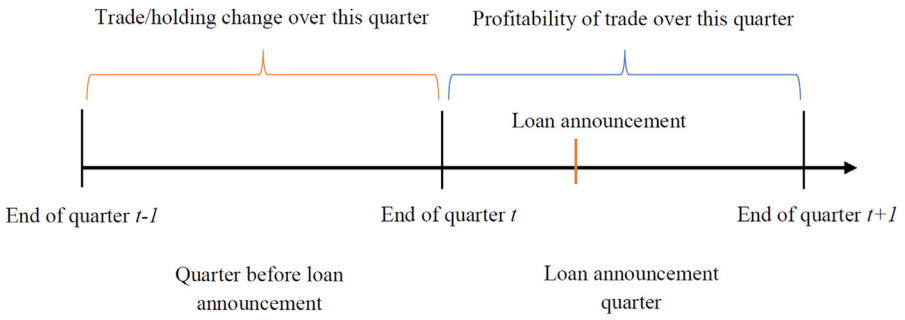

Fig. 1. Timeline of hedge fund holding changes and trade profitability. This figure provides a timeline to illustrate the calculation of trade profitability measures. Ownership change or trade, $\Delta Ownership_{i,j,t}$, is measured as the change in holdings of stock j by hedge fund company i from the end of quarter t-1 to the end of quarter t, scaled by the fund company AUM. It is essentially the change in portfolio weight in quarter t. Abnormal stock performance, $Return_{j,t+1}$, is measured from the end of quarter t to the end of quarter $t + 1$. The trade profitability measure is calculated by multiplying the ownership change in quarter t and the abnormal stock return in quarter $t + 1$ (i.e., $\Delta Ownership_{i,j,t} \times Return_{j,t+1}$). Hence, in the context of a loan event, if the loan is announced during quarter $t + 1$, as shown below, the trade performance measure of interest in our analysis is the product of ownership change over the quarter before loan announcement (i.e., quarter t) and abnormal stock return during the loan announcement quarter (i.e., quarter $t + 1$). This ensures that ownership change does not capture trade decisions driven by the public announcement of the loan.

then the funds' trades should reflect this. Therefore, in our empirical analysis, we test whether hedge funds make informed trades on the stocks of firms to which their prime broker bank originates loans. We refer to the stocks of firms that receive a bank loan as treated stocks and the hedge funds whose prime broker bank is the lead arranger of the loan as connected funds. We have two conjectures concerning the effect of an information edge due to connections to prime broker banks. First, we expect these hedge fund clients to exhibit abnormal trading activity (i.e., make larger trades) in treated stocks prior to the loan announcements. Second, we expect the trades in treated stocks by connected hedge funds to be more profitable when compared to appropriate control groups.

To examine these effects, we use the data set described in Section 2 that combines data on hedge funds, hedge fund prime broker banks, loan originations, and hedge fund firm 13F stock holdings. Our unique setting allows us to explore both (i) across-stock variations within each hedge fund portfolio and (ii) across-fund variation within each stock event.[13] We illustrate our empirical design with the following example. Hedge fund H1 uses prime broker P1. Hedge fund H2 uses prime broker P2. Both funds own and trade in Microsoft and Apple shares. Prime broker P1's affiliated bank makes a loan to Microsoft. We refer to Microsoft as the treated stock and H1 as the connected hedge fund. If our hypothesis is true, H1 would be better informed about Microsoft. Our analysis examines whether H1 makes larger and more profitable trades in Microsoft prior to the loan announcement (i.e., trades in treated stock by connected fund) compared to other trades (e.g., H1's trades in Apple and H2's trades in Microsoft).

In particular, we carry out the following regression to test our hypothesis:

$$y_{i,j,t} = \beta * Loan_{i,j,t} + \gamma_{i,t} + \kappa_{j,t} + \eta_{i,j,t}, \quad (1)$$

where i indexes hedge fund company, j indexes stocks, and t indexes time. The dependent variable is either the size or next-quarter performance of the trade by hedge fund company i in stock j in quarter t. $Loan_{i,j,t}$ is an indicator variable that equals one if hedge fund company i's prime broker bank makes a loan as a lead arranger to stock j in the subsequent quarter, (i.e., quarter $t + 1$), and zero otherwise. $\gamma_{i,t}$ represents fund company × quarter fixed effects, which allows us to control for both observable and unobservable time-variant fund company characteristics. Similarly, $\kappa_{j,t}$ represents stock × quarter fixed effects and allows us to control for both observable and unobservable time-variant stock characteristics. Standard errors are adjusted for heteroskedasticity and are three-way clustered by fund company, stock, and quarter to account for potential correlations in the residuals within a fund company, within a stock, and within a given quarter.

Essentially, our regression specification simultaneously explores (i) across-stock variations within each hedge fund portfolio and (ii) across-fund variation within each stock event. Our unique setting allows us to include both sets of high-dimensional fixed effects in the regressions.[14] For a given loan event, certain hedge funds are connected based on their prime broker banks, whereas others are not. This variation allows us to include stock × quarter fixed effects. Similarly, for a given hedge fund company in a quarter, some of the fund's stock positions are in firms that obtain a loan from the fund's prime broker banks, while other stock positions are in firms that either do not obtain a loan or obtain a loan from a different bank. This variation allows us to use fund company × quarter fixed effects. Using our example above where Microsoft receives a loan, this test uses all four types of trades in the estimation and filters out any time-variant omitted variable specific to hedge fund H1 or Microsoft in that quarter.[15]

Controlling for time-variant fund company and stock characteristics is necessary to address concerns that (i) treated stocks are different from nontreated stocks and

[13] As mentioned earlier, we only observe portfolio holdings at the hedge fund company level. We use hedge fund and hedge fund company interchangeably in the context of portfolio holdings.

[14] We also find similar results if we include only one set of the high-dimensional fixed effects, either fund company × quarter or stock × quarter fixed effects (see Tables IA.1-3 of the Internet Appendix for details).

[15] Note that the four types of trades include H1's trades in Microsoft, H1's trades in Apple, H2's trades in Microsoft, and H2's trades in Apple.

(ii) connected hedge funds are different from nonconnected funds. In particular, it eliminates the following two concerns at the same time: (i) value-relevant nonpublic information about the treated loan stock can reach both connected and nonconnected hedge funds through other channels; (ii) connected hedge funds might be more skilled and thus make informed trades in both treated and untreated stocks. In summary, this specification allows us to control for many potential confounding effects and rules out alternative explanations that connected hedge funds make informed trades in treated stocks for reasons unrelated to their prime broker connections.

4. Empirical results

In this section, we first discuss the baseline results on hedge fund trading before loan announcement. We next analyze whether certain subsets of hedge funds have a larger information advantage. We then study whether the information edge relates to the information asymmetry of the borrowing firm. After that, we carry out several tests to investigate the information content and means of information transmission. Last, we discuss the implications of our empirical findings.

4.1. Hedge fund trading before loan announcements

In this section, we examine hedge funds' trades in the stocks of firms to whom their prime broker bank initiates a loan as a lead arranger. We first present the baseline results and then carry out several robustness analyses.

4.1.1. Baseline results

We start with analyzing hedge funds' trade size in the calendar quarter before a loan announcement. We define a loan event as an instance where a bank initiates a loan to a firm. Our hypothesis is that, if hedge funds obtain an information advantage about these stocks from their connections to prime broker banks, they will make bigger size changes in their portfolios for these treated stocks in the quarter before the loan event.

To test this hypothesis, we estimate a regression as in Eq. (1), as discussed in Section 3 above. However, unlike other events like mergers, the direction of the stock price reaction to the announcement of a loan is not obvious ex-ante. In fact, just 47.6% of these loan events have positive three-day (−1 day to +1 day) cumulative abnormal returns. For this reason, we use $|\Delta Ownership|_{i,j,t}$, the absolute value of the change in fund company i's ownership in stock j from the end of quarter t-1 to the end of quarter t, scaled by fund company's AUM, as the dependent variable in these regressions. This is essentially the change in portfolio weight from quarter t-1 to quarter t. Note that quarter t refers to the quarter prior to the loan announcement quarter in our regression specifications. We use the change in stock holdings for the quarter prior to the loan announcement to ensure that we are not capturing trade decisions driven simply by the public announcement of the loan. Because our regressions include both fund company × quarter and stock × quarter fixed effects, any potential fund company or stock control variables would be subsumed by these fixed effects.

We present the estimation results in column (1) of Table 2. The key coefficient of interest, *Loan*, is positive and statistically significant at the 1% level. Specifically, the coefficient on *Loan* is 0.058 with a t-statistic of 3.94. Our result indicates that connected hedge funds make trades in treated stocks that are 5.8 bps larger in size than the trades in the control groups. Given that the sample mean and median of $|\Delta Ownership|$ are 31.7 bps and 6.3 bps, respectively, this effect is economically large.

Next, we investigate whether connected hedge funds have abnormal performance in their trades of these treated stocks. To do so, we estimate the regression described in Eq. (1) in which the dependent variable is a measure of trade performance. The trade performance measures are calculated at the fund-stock-quarter level by combining information on a given stock's abnormal return over a quarter and a given fund's holding change on that stock in the prior quarter. The quarterly nature of the 13F holdings data dictates our choice of the trade and return windows. We calculate a stock's cumulative abnormal return over each calendar quarter. We use the change in ownership from the quarter prior to the loan announcement quarter to remove any influence of the public announcement on the hedge funds' portfolio decisions.

Specifically, as shown in Fig. 1, our trade profitability measure equals the product of the fund's change in ownership scaled by AUM in the calendar quarter before the loan announcement and the stock abnormal return in the subsequent quarter (i.e., the quarter of the loan announcement). Our measures capture the incremental contribution to the fund company's quarterly abnormal return from the trade in a given stock. It is important to note that this calculation "signs" and "scales" a given stock return variable for each fund based on the direction and size of that fund's trade. We compare the performance of connected funds' trading in the stocks receiving loans to other trades using these profitability measures.

We present the results in columns (2) and (3) of Table 2. The coefficients on *Loan* are positive and statistically significant at the 1% level in both cases (with t-statistic being 3.74 in column (2) and 3.12 in column (3)). Our results indicate that connected funds' trades in treated stocks outperform other types of trades by 0.291 and 0.244 bps per quarter based on *Four-factor alpha* and *DGTW*, respectively. These estimates are economically significant, as their magnitudes are almost four times as large as the sample average of 0.07 bps per quarter. Given that the average connected fund company in our sample has AUM of $2837.7 million, this outperformance translates to an additional $69,240–$82,578 in abnormal quarterly profits per trade for a connected hedge fund company. Given that the average connected fund company holds 5.8 treated stocks in a given quarter, this result suggests that the fund company is generating additional abnormal profits of $401,600–$479,000 per quarter from their trades in the stocks of firms to whom the fund's prime broker bank provides a loan as a lead arranger.

We confirm that the superior performance we show in Table 2 is driven by an information edge rather than

Table 2
Hedge fund trading before loan announcements.
This table reports results that compare the size and returns on hedge fund trades in stocks of firms that receive loans from their prime broker banks to that of other trades in the control groups. Trade size is calculated as the absolute change in ownership (in percentage points of assets under management). We calculate trade returns as $\Delta Ownership_{i,j,t} \times Return_{j,t+1}$ (i.e., the product of hedge fund company *i*'s portfolio weight change in stock *j* in quarter *t* and the subsequent quarter stock abnormal return). $Return_{j,t+1}$ is either the cumulative Carhart (1997) four-factor alpha or DGTW-adjusted return for stock *j* over the quarter $t + 1$. Column (1) contains the results for trade size, while columns (2) and (3) contain the results for trade profitability. All regressions are estimated based on Eq. (1) with both fund company × quarter and stock × quarter fixed effects. The variable of interest is *Loan*, an indicator variable equal to one if hedge fund company *i*'s prime broker bank initiates a loan as a lead arranger to stock *j* in quarter $t + 1$, and zero otherwise. Standard errors are adjusted for heteroskedasticity and are three-way clustered by fund company, stock, and quarter, and *t*-statistics are reported below the coefficients in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

	(1) |ΔOwnership|	(2) Four-factor alpha × ΔOwnership	(3) DGTW × ΔOwnership
Loan	0.058***	0.291***	0.244***
	(3.94)	(3.74)	(3.12)
Fund comp. × Qtr. FE	Yes	Yes	Yes
Stock × Qtr. FE	Yes	Yes	Yes
Observations	1,748,255	1,748,255	1,746,357
Adj. R-squared	0.434	0.031	0.032

Table 3
Information or temporary price pressure?
This table reports the estimation results of Eq. (1) to examine whether the information advantage that hedge funds gain from their prime broker connection is permanent or temporary. The dependent variable is trade returns, $\Delta Ownership_{i,j,t} \times Return_{j,t+k}$ (i.e., the product of hedge fund company *i*'s portfolio weight change in stock *j* in quarter *t* and a subsequent quarter stock abnormal return). $Return_{j,t+k}$ is either the cumulative Carhart (1997) four-factor alpha or DGTW-adjusted return for stock *j* over the quarter $t + k$ where $k = 1, 2, 3,$ or 4. The indicator variable *Loan* is defined the same way as in Table 2. Note that the results in columns (1) and (5) of this table are the same as in columns (2) and (3) of Table 2, respectively. Standard errors are adjusted for heteroskedasticity and are three-way clustered by fund company, stock, and quarter, and *t*-statistics are reported below the coefficients in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

	Four-factor alpha × ΔOwnership				DGTW × ΔOwnership			
	(1) $t+1$	(2) $t+2$	(3) $t+3$	(4) $t+4$	(5) $t+1$	(6) $t+2$	(7) $t+3$	(8) $t+4$
Loan	0.291***	0.080	−0.067	0.030	0.244***	0.063	−0.049	0.081*
	(3.74)	(1.04)	(−1.16)	(0.62)	(3.12)	(0.86)	(−0.81)	(1.92)
Fund comp. × Qtr. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stock × Qtr. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,748,255	1,715,678	1,686,264	1,657,672	1,746,357	1,713,807	1,684,380	1,655,800
Adj. R-squared	0.031	0.030	0.029	0.028	0.032	0.030	0.029	0.028

temporary price pressure. Specifically, we examine the returns connected funds would earn over the next four quarters on their trades in the connected loan stocks. We use the product of holding changes in the quarter before loan announcement and stock abnormal return during each of the next four quarters as the dependent variable in the analysis. If the higher returns that connected funds earn are driven by temporary price pressure, any trading profits we observe should reverse in subsequent quarters. The results of these tests are presented in Table 3.

We find no evidence of price reversal in the following three quarters. Furthermore, we conduct a number of additional tests to ensure that the results in Table 2 are not entirely driven by hedge fund firms of certain sizes or by prime broker banks of certain sizes (see Tables IA.4 and IA.5 of the Internet Appendix, respectively).[16] Finally, we conduct placebo tests in which we change the loan initiation dates to one or two years prior to the actual dates. We do not find any evidence of information advantage during the placebo periods (see Table IA.9 of the Internet Appendix), which suggests that the information edge that connected funds have is specific to the time period in which their prime broker bank is actually making the loan.

[16] We also carry out several other robustness tests. First, we find that connected hedge funds' trades of treated stocks are more profitable when these funds initiate new positions (i.e., when they previously did not hold the treated stock). We report the results in Table IA.6 of the Internet Appendix. This evidence further suggests that connected hedge funds gain an information edge during the time period of loan initiation. Second, we find no evidence of information advantage if we repeat our analysis for a sample of quant hedge fund firms (see Tables IA.7 of the Internet Appendix). This evidence is consistent with the fact that quant hedge fund firms do not engage in "stock picking" but mainly base their strategies on statistical analyses. Finally, we divide the loan events in our sample based on when the loan occurs during the quarter and find that our results are stronger for the loan events announced in the first half of the quarter (see Tables IA.8 of the Internet Appendix). This finding is consistent with the idea that the 13F holdings changes from the beginning to the end of quarter *t* are more likely to reflect informed trading if the loan was announced in the first half of quarter $t + 1$. For example, if a loan deal is closed and is publicly announced late in a calendar quarter (e.g., September 20th), it is less likely that the lead bank would have already performed the necessary due diligence and uncovered valuable nonpublic information by the end of the previous quarter (e.g., June 30th).

Table 4
Information edge of connected hedge fund: portfolio tests.
This table reports the performance of portfolios based on connected hedge funds' trades in stocks of firms that receive loans from their prime broker banks versus portfolios based on other trades in the control group. For each fund, we form four distinct portfolios at the beginning of each quarter based on (1) whether the fund bought or sold a stock during the previous quarter and (2) whether the trade was of a stock that received a loan from the fund's prime broker bank (i.e., connected loan stock or not). Stocks that are bought are aggregated into the buy portfolio, while those that are sold are placed in the sell portfolio. We create two subgroups within the buy and sell portfolios: connected loan stocks and other stocks. We calculate the average monthly returns of these portfolios for each fund in each quarter, weighting each stock's return in the portfolios by the dollar trade value during the previous quarter. We rebalance at the end of the quarter. We then average the returns of each sub-portfolio across the funds in our sample using the dollar assets (TNA) of each fund in the previous quarter as weights, producing value-weighted average monthly returns for each of the four portfolios. Columns (1) and (2) report the risk-adjusted average monthly returns of the connected loan buy and sell portfolios, respectively. Risk adjustment is based on both DGTW benchmark returns and the Carhart (1997) four-factor alpha. Columns (4) and (5) report the corresponding results for the buy and sell portfolios for other stocks. Finally, columns (3) and (6) describe the difference of the returns of the buy and sell portfolios for the connected loan stocks and other stocks, respectively, and column (7) provides the difference-in-difference estimate. *t*-statistics are reported in parentheses. Significance levels for tests of difference in means are denoted by ***, **, and *, which correspond to 1%, 5%, and 10% levels, respectively.

	Connected loan stocks			Other stocks			
	Buys (1)	Sells (2)	Diff. (3)	Buys (4)	Sells (5)	Diff. (6)	Diff. − Diff. (7)
Raw return	1.48%	0.03%	1.45%***	0.99%	0.88%	0.11%	1.34%***
			(3.07)			(0.70)	(2.96)
DGTW	0.57%	−0.85%	1.42%***	0.05%	0.02%	0.03%	1.39%***
			(2.98)			(0.29)	(2.97)
Four-factor alpha	0.64%	−0.68%	1.32%***	0.19%	0.21%	−0.03%	1.35%***
			(2.89)			(−0.23)	(2.90)

In addition to the regression analysis above, we carry out tests using a portfolio approach to examine connected funds' information advantage. In particular, we follow the portfolio approach of Pool et al. (2015), which has a similar setting with stock returns and fund holding changes. If connected funds' trades before loan announcements are informed, a long-short portfolio that buys the loan stocks these funds bought and sells the loan stocks that these funds sold will generate higher abnormal returns, compared to a similar long-short portfolio that mimics the trades in the control group. Specifically, in the portfolio tests, for each fund-quarter, we form four portfolios of stocks based on whether (i) the fund bought or sold the stock and (ii) the fund's prime broker bank was the lead arranger of a loan to the stock in that quarter (i.e., connected loan stock or not). We calculate the average return for each of the four portfolios using the dollar trade value of the previous quarter as each stock's weight and rebalance the portfolios each quarter. Then, we calculate AUM value-weighted average monthly returns of each portfolio across the funds in our sample and use the Carhart (1997) four-factor model or DGTW benchmark portfolios to compute abnormal returns. We report the results in Table 4. Regardless of the performance measure used, the long-short portfolio of connected loan stocks significantly outperforms the long-short portfolio of other stocks. Specifically, the difference-in-difference portfolio has a positive *Four-factor alpha* and *DGTW* of 1.39% and 1.34% per month, respectively, both significant at the 1% level. This evidence provides further support that connected hedge funds have an information edge in loan stocks ahead of loan announcement.

Taken together, these results show that the connected hedge funds make abnormally large size trades prior to the loan announcement and these trades display superior performance—supporting the hypothesis that these hedge funds gain an information advantage from their connections to prime broker banks.

4.1.2. Lead versus nonlead banks

In a syndicated loan, the lead arranger establishes a relationship with the firm, performs screening and due diligence, and negotiates terms of the contract. The lead arranger then turns to participants to arrange commitments to fund portions of the loan (e.g., Dennis and Mullineaux, 2000; Sufi, 2007; Ivashina, 2009). While the participants receive an "information memorandum" from the lead that contains descriptive and financial information concerning the borrower, participants are not involved in due diligence or negotiations with the borrower. Hence, we do not expect the participant lenders to have all nonpublic information about the borrower that the lead uncovers during the due diligence process. Consequently, hedge funds whose prime broker banks participate in loans but do not perform the role of lead arranger might not gain an information edge.

To test this hypothesis, we estimate the following linear regression:

$$y_{i,j,t} = \beta_1 * Lead\ arranger_{i,j,t} * Loan\_Any\_Participant_{i,j,t} + \beta_2 * Loan\_Any\_Participant_{i,j,t} + \gamma_{i,t} + \kappa_{j,t} + \eta_{i,j,t}, \quad (2)$$

where the dependent variable is trade performance described earlier; $Loan\_Any\_Participant_{i,j,t}$ is an indicator variable that equals one if hedge fund company *i*'s prime broker bank is a lender (either lead arranger or participant lender) of the loan to stock *j* in quarter $t + 1$, and zero otherwise; $Lead\ arranger_{i,j,t}$ is an indicator variable that equals one if fund company *i*'s prime broker bank is the lead arranger of the loan to stock *j* in quarter $t + 1$, and zero otherwise; $\gamma_{i,t}$ represents fund company × quarter fixed effects; and $\kappa_{j,t}$ represents stock × quarter fixed effects.[30]

[30] Note that $Lead\ arranger_{i,j,t}$ is only defined if fund i's prime broker bank is a lending bank (either lead arranger or participant lender)

Table 5
Information gathering by banks.
This table examines the relationship between the trade performance of connected hedge funds and information gathering by their prime broker banks during the lending process. The dependent variable is trade returns, $\Delta Ownership_{i,j,t} \times Return_{j,t+1}$ (i.e., the product of hedge fund company *i*'s portfolio weight change in stock *j* in quarter *t* and the subsequent quarter stock abnormal return). $Return_{j,t+1}$ is either the cumulative Carhart (1997) four-factor alpha or DGTW-adjusted return for stock *j* over the quarter $t + 1$. Panel A reports estimation results of Eq. (2) to examine whether the information advantage that connected hedge funds gain is greater when their prime broker bank is the lead arranger compared to just being a participant lender. $Loan\_Any\_Participant_{i,j,t}$ is an indicator variable that equals one if hedge fund company *i*'s prime broker bank is a lender (either lead arranger or participant lender) of the loan to stock *j* in quarter $t + 1$, and zero otherwise; $Lead\ arranger_{i,j,t}$ is an indicator variable that equals one if fund company *i*'s prime broker bank is the lead arranger of the loan to stock *j* in quarter $t + 1$, and zero otherwise. Panel B reports the estimation results of Eq. (3) to examine whether the information advantage that connected hedge funds gain is greater when their prime broker bank is lending to a firm for the first time. The indicator variable *Loan* is defined the same way as in Table 2. The indicator variable $New\ relationship_{i,j,t}$ equals one if the loan event occurring during quarter *t* is firm *j*'s first loan from hedge fund *i*'s prime broker bank, and zero otherwise. The analyses in both panels use fund company × quarter and stock × quarter fixed effects. Standard errors are adjusted for heteroskedasticity and are three-way clustered by fund company, stock, and quarter, and *t*-statistics are reported below the coefficients in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

Panel A. Lead versus nonlead banks

	(1) Four-factor alpha × ΔOwnership	(2) DGTW × ΔOwnership
Loan_Any_Participant × Lead arranger	0.228**	0.196**
	(2.61)	(2.28)
Loan_Any_Participant	0.102	0.076
	(1.40)	(1.05)
Fund comp. × Qtr. FE	Yes	Yes
Stock × Qtr. FE	Yes	Yes
Observations	1,748,255	1,746,376
Adj. R-squared	0.031	0.032

Panel B. New versus existing relationship

	(1) Four-factor alpha × ΔOwnership	(2) DGTW × ΔOwnership
Loan × New relationship	0.407**	0.388**
	(2.14)	(2.19)
Loan	0.196**	0.153*
	(2.31)	(1.90)
Fund comp. × Qtr. FE	Yes	Yes
Stock × Qtr. FE	Yes	Yes
Observations	1,748,255	1,746,357
Adj. R-squared	0.031	0.032

The results of this analysis are reported in Table 5, Panel A. We find that the coefficient on *Loan_Any_Participant* is small and statistically indistinguishable from zero. The interaction term, which captures the difference between the lead arranger and participant lenders, is positive and statistically significant at the 5% level in both columns. It suggests that hedge funds whose prime broker banks are mere participants in a loan do not gain the same information edge as hedge funds whose prime broker banks are lead arrangers. This result highlights the unique role of lead prime broker banks in the information brokerage function that we show in this paper.

Prior literature shows that the loan participants get "hard" information, while the lead arranger gets both "soft" and hard information (e.g., Liberti and Petersen, 2018).[17] To that extent, our evidence suggests that interpersonal interactions with the prime broker bank (e.g., with in-house equity analyst and key banking personnel or at exclusive meetings) allows hedge funds to pick up valuable soft information about the borrower that is exclusive to the lead arranger.

in a given loan. Essentially, this variable categorizes the observations with $Loan\_Any\_Participant_{i,j,t} = 1$ into two groups. Hence, $Lead\ arranger_{i,j,t}$ is not defined for the observations in the control groups ($Loan\_Any\_Participant_{i,j,t} = 0$) and the variable itself does not enter directly in the regression.

[17] As Liberti and Petersen (2018) point out, soft information can only be collected in person (e.g., in the due diligence process in our case). We believe that a large portion of the private information the lead arranger has about the borrower is soft in nature. The soft information could include additional value-relevant information regarding management's opinions, future plans, and financial projections that would not be available to participants who only get the hard information.

4.1.3. New versus existing bank relationship

We next examine whether the information advantage hedge funds receive is stronger when their prime broker bank lends to a borrowing firm for the first time compared to when the bank is a repeat lender for the firm. Repeated lending reduces the information gap between the lead bank and the borrower (e.g., Petersen and Rajan, 1994). It is more likely for a bank to uncover material new information during due diligence when the bank is lending to a borrower for the first time than when it is lending for, say, the fifth time. Hence, we expect the information advantage that funds receive would be greater in the case of a new lending relationship.

To test this hypothesis, we estimate the following linear regression:

$$y_{i,j,t} = \beta_1 * New\ relationship_{i,\ j,t} * Loan_{i,j,t} + \beta_2 * Loan_{i,j,t} + \gamma_{i,t} + \kappa_{j,t} + \eta_{i,j,t}, \quad (3)$$

where the dependent variable is trade performance described earlier; $Loan_{i,j,t}$ is an indicator variable that equals one if hedge fund company *i*'s prime broker bank makes a loan as a lead arranger to stock *j* in quarter *t + 1*, and zero otherwise; $New\ relationship_{i,\ j,\ t}$ represents an indicator variable that equals one if the loan event occurring during quarter $t + 1$ is firm *j*'s first loan from hedge fund *i*'s prime broker bank, and zero otherwise; $\gamma_{i,\ t}$ represents fund company × quarter fixed effects; and $\kappa_{j,\ t}$ represents stock × quarter fixed effects.[18]

The results of these regressions are presented in Panel B of Table 5. Consistent with our hypothesis, we find that the coefficients on the interaction term are positive and statistically significant at the 5% level in both columns. These results indicate that the information advantage funds receive is greater when their prime broker banks are lending to new clients compared to clients with existing relationships. Equally important, the coefficient on *Loan* remains positive and statistically significant, which suggests that funds still gain an information advantage when firms borrow from a bank that has lent to them in the past.

4.2. Information edge in the cross-section of hedge funds

We now turn our attention to exploring whether certain subsets of hedge funds benefit more from their prime broker connections. Our focus is on two specific fund company characteristics: (i) revenue potential for prime broker banks and (ii) fund companies' proclivity to push the boundaries as proxied by misconduct or violations of regulations reported in Form ADV.

4.2.1. Revenue potential for prime brokers

In this section, we examine whether the information advantage that connected hedge funds have is increasing in their potential to generate revenue for the prime broker bank. To test this conjecture, we carry out the following regression:

$$y_{i,j,t} = \beta_1 * I_{i,t} * Loan_{i,j,t} + \beta_2 * Loan_{i,j,t} + \gamma_{i,t} + \kappa_{j,t} + \eta_{i,j,t}, \quad (4)$$

where the dependent variable is trade performance as described earlier; $I_{i,\ t}$ represents an indicator variable that proxies for hedge fund *i*'s revenue generation potential to banks; $\gamma_{i,\ t}$ represents fund company × quarter fixed effects; and $\kappa_{j,\ t}$ represents stock × quarter fixed effects. Note that the direct effect of the indicator variable gets absorbed in the fund company × quarter fixed effects. The estimation results are reported in Panel A of Table 6.

Since we do not directly observe the fees each hedge fund client pays to its broker(s), we use two proxies for this variable. Our first proxy for this variable is the level of a fund company's AUM in long-short equity strategies. Because prime brokers earn commissions by executing trades and providing financing for leveraged and short positions, fund companies that primarily trade in equities and those who take short positions presumably generate more revenue for the prime brokers.[19] We expect investment banks to maintain stronger relationships with these clients. For this reason, we expect that these hedge fund clients will perform better on the loan stocks in their portfolios. In particular, we construct an indicator variable, *Revenue proxy*, to be equal to one when a fund company is in the top quartile of equity AUM and zero otherwise. If larger revenue potential leads to a greater information edge for hedge fund clients, we expect the coefficient on *Loan* × *Revenue proxy* to be positive and statistically significant.

We present the estimation results in columns (1) and (2) of Panel A. The evidence supports our prediction. The coefficients on the interaction terms are large and statistically significant at the 5% level for both profitability measures. Connected fund companies with high levels of equity AUM outperform connected funds with lower equity AUM on their trades of treated stocks by 0.430–0.450 bps per quarter. In dollar terms, the information advantage corresponds to $2.8 million and $2.7 million in additional abnormal trading profits per quarter by an average connected fund company in the high equity AUM group compared to the nonconnected fund companies in the control group.

Next, we consider another source of revenue for prime brokers—funds' use of leverage financing. Our financing measure for each fund company is constructed by multiplying the AUM of each equity fund by an indicator variable that takes the value of one if the fund uses leverage or margin financing and zero otherwise. The indicator variable *Revenue proxy* equals one when a fund company is in the top quartile of our measure of financing and zero otherwise. The results of this analysis are reported in

[18] Note that $New\ relationship_{i,\ j,\ t}$ is only defined if fund *i*'s prime broker bank is a lead arranger in a given loan. Essentially, this variable categorizes the observations with $Loan_{i,\ j,\ t} = 1$ into two groups. Hence, $New\ relationship_{i,\ j,\ t}$ is not defined for the observations in the control groups ($Loan_{i,\ j,\ t} = 0$) and the variable itself does not enter directly in the regression.

[19] A report by Barclays Capital Solutions Group in 2015, titled "More with less – impact of regulations on the hedge fund financing model," notes that long-short equity and statistical arbitrage funds are the two most valuable types for prime brokerage revenues. Statistical arbitrage funds do not have a large impact in our setting given their investment strategies are unlikely to rely on the type of fundamental information obtained from corporate lending activities.

Table 6
Fund characteristics and performance of hedge funds' trades.
This table reports the estimation results of Eq. (4) to examine whether the information advantage that hedge funds gain from their prime broker connections is related to certain fund characteristics. The dependent variable is trade returns, $\Delta Ownership_{i,j,t} \times Return_{j,t+1}$ (i.e., the product of hedge fund company i's portfolio weight change in stock j in quarter t and the subsequent quarter stock abnormal return). $Return_{j,t+1}$ is either the cumulative Carhart (1997) four-factor alpha or DGTW-adjusted return for stock j over the quarter $t + 1$. The indicator variable *Loan* is defined the same way as in Table 2. Panel A examines fund company's revenue potential for prime brokers. In columns (1) and (2), revenue potential is measured by hedge funds' AUM in equity styles (e.g., long-short or market neutral). The indicator variable, *Revenue proxy*, equals one when a hedge fund company is in the top quartile of equity AUM and zero otherwise. In columns (3) and (4), revenue potential is measured by hedge funds' use of prime broker financing. The variable, *Revenue proxy*, equals one when a fund company is in the top quartile of leverage usage and zero otherwise. Leverage usage is measured by multiplying the AUM of a fund by an indicator variable that takes the value of one if the fund uses leverage or margin financing. Panel B examines fund company's engagement in misconduct or illegal activities. The indicator variable, *ADV violation*, equals one if a fund company has disclosed any civil, regulatory, or criminal violation in Form ADV, and zero otherwise. In both panels, standard errors are adjusted for heteroskedasticity and are three-way clustered by fund company, stock, and quarter, and t-statistics are reported below the coefficients in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

Panel A. Revenue potential

	Proxy = Equity AUM		Proxy = High leverage	
	(1) Alpha × ΔOwnership	(2) DGTW × ΔOwnership	(3) Alpha × ΔOwnership	(4) DGTW × ΔOwnership
Loan × Revenue proxy	0.430**	0.450**	0.538**	0.498**
	(2.07)	(2.12)	(2.24)	(2.18)
Loan	0.125*	0.085	0.145*	0.122*
	(1.82)	(1.27)	(1.96)	(1.78)
Fund comp. × Qtr. FE	Yes	Yes	Yes	Yes
Stock × Qtr. FE	Yes	Yes	Yes	Yes
Observations	1,651,892	1,650,122	1,469,026	1,467,441
Adj. R-squared	0.034	0.034	0.036	0.036

Panel B. ADV violations

	ADV violation = Any		ADV violation = Civil or regulatory	
	(1) Alpha × ΔOwnership	(2) DGTW × ΔOwnership	(3) Alpha × ΔOwnership	(4) DGTW × ΔOwnership
Loan × ADV violation	0.403**	0.414**	0.409**	0.401**
	(2.40)	(2.50)	(2.32)	(2.31)
Loan	0.161**	0.151*	0.163**	0.157**
	(2.31)	(1.90)	(2.37)	(1.98)
Fund comp. × Qtr. FE	Yes	Yes	Yes	Yes
Stock × Qtr. FE	Yes	Yes	Yes	Yes
Observations	1,136,146	1,135,280	1,136,146	1,135,280
Adj. R-squared	0.024	0.026	0.024	0.026

columns (3) and (4) of Panel A. We find that connected funds with higher broker financing outperform other connected funds with lower broker financing on their trades of treated stocks by 0.498–0.538 bps per quarter, both significant at the 5% level. In summary, these results provide further evidence in support of our main hypothesis and suggest that the information advantage to hedge fund firms depends on their revenue generation potential to prime broker banks.

4.2.2. Violations and misconduct

The next fund characteristic we study is the fund company's proclivity to engage in misconduct or violations of regulations. Prior literature has found that fund managers that engaged in legal or regulatory misconduct are more likely to engage in higher risk-taking and have higher operational risk (e.g., Brown et al., 2008; 2018). For this reason, we expect that this group of funds is more likely to exploit any information advantage derived from their connections to prime broker banks.

To examine this hypothesis, we match our sample of fund companies to their Form ADV filings. We create an indicator variable, *ADV violation*, that equals one if a fund company discloses any prior civil, regulatory, or criminal violation in Item 11 of its Form ADV file and zero otherwise. We find that 17.6% of hedge fund firms in our sample have at least one of these violations during the sample period. It is important to note that hedge funds were not required to file Form ADV until 2008, so the sample size for this analysis is smaller than that of our baseline analysis in Table 2. Specifically, we estimate the regression in Eq. (4), where $I_{i,t}$ represents an indicator variable that captures whether or not a hedge fund company engaged in misconduct or violations of regulations based on Form ADV.

We present the estimation results in Panel B of Table 6. Overall, the results in that panel support our hypothesis. Columns (1) and (2) contain the results when we construct *ADV violation* based on the disclosure of any prior civil, regulatory, or criminal violations, while columns (3) and (4) use a version of *ADV violation* that is solely based on civil and regulatory violations since these violations are

closer in spirit to insider trading violations.[20] We find that the coefficients on the interaction term are positive in all four columns, ranging from 0.401 to 0.414, and all of them are statistically significant at the 5% level. Thus, connected hedge funds that have previously engaged in malfeasance gain a bigger information edge in their trades of treated stocks compared to other connected funds.[21]

4.3. Information asymmetry and hedge fund trading performance

The information edge that a connected hedge fund can potentially derive from the connection to their prime broker banks depends on the information asymmetry between insiders of a firm and the outside market. Prior literature has shown that investment managers invest more and perform better in their trades of more opaque firms when they have an information advantage in those stocks (e.g., Coval and Moskowitz, 2002; Teo, 2009). We construct two proxies for high information asymmetry about the borrowing firm and estimate the following regression:

$$y_{i,j,t} = \beta_1 * I_{j,t} * Loan_{i,j,t} + \beta_2 * Loan_{i,j,t} + \gamma_{i,t} + \kappa_{j,t} + \eta_{i,j,t}, \quad (5)$$

where the dependent variable is trade performance described earlier; $I_{j,t}$ represents an indicator variable that equals one if stock j in quarter t is subject to high information asymmetry and zero otherwise; $\gamma_{i,t}$ represents fund company × quarter fixed effects; and $\kappa_{j,t}$ represents stock × quarter fixed effects. Note that the direct effect of the indicator variable gets absorbed in the stock × quarter fixed effects.

Our first proxy for high information asymmetry about the borrowing firm is based on the firm's senior unsecured ratings.[22] In the regression specification, $I_{j,t}$ equals one when a borrower does not have an investment-grade rating (i.e., either has a speculative-grade rating or is not rated at all). Panel A of Table 7 reports the results of this analysis. Consistent with our hypothesis, we find that connected funds' outperformance is greater in their trades in treated stocks with high information asymmetry. The coefficients on the interaction term, *Loan* × *Speculative /Unrated*, are 0.306 and 0.232 for *Alpha* and *DGTW*, respectively, and are statistically significant at the 10% level or better.

Next, we use the number of lead arrangers as proxies for underlying information asymmetry between borrowers and the outside market. Sufi (2007) finds that syndicate sizes are small when borrowing firms have high information asymmetry. When information asymmetry is not a concern, syndicates are large and the loan resembles a public debt. Hence, we expect that connected funds' information advantage would be higher for loans that have a single lead arranger.[23] Panel B of Table 7 reports the results of this analysis. We find that connected hedge funds perform significantly better when the loan has a single lead arranger as compared to loans with multiple lead arrangers. Specifically, the coefficients on the interaction term, *Loan* × *Sole Lead*, are 0.273 and 0.282 for *Alpha* and *DGTW*, respectively, and are statistically significant at the 10% level or better.

4.4. Information content and means of transmission

In this section, we conduct several analyses to shed light on what type of information connected hedge funds receive and how information could be transmitted from prime broker banks to hedge funds. First, we examine whether the information edge funds gain is specifically about the loan or the borrowing firm's fundamentals. Second, we analyze what type of information could explain connected hedge funds' superior trade performance. Last, we present some evidence on a potential conduit for information transfer between the prime broker bank and the hedge funds. We discuss these analyses in order in the next three sections.

4.4.1. Information about the loan or the firm?

We begin by examining whether connected funds are gaining information specific to a given loan contract or whether they are gaining more general information about the borrowing firm that is uncovered during the due diligence process. To answer this question, we decompose quarterly abnormal stock returns of the loan announcement quarter into two components: (i) a three-day cumulative abnormal return (−1 day to +1 day) around a loan initiation date and (ii) the remaining component (i.e., quarterly abnormal return minus the three-day cumulative abnormal return (CAR)). We then reestimate the regression in Eq. (1) using each of the two return components to calculate our trade performance measures.

If the information edge is purely about the details of the loan contracts, then the connected hedge funds' trading profits should be driven by the announcement return when loan details are publicly disclosed. In this scenario, we would expect the coefficient on *Loan* to be positive and significant when the return component in our dependent variable is the three-day CAR around loan announcement and for the coefficient on *Loan* to be insignificant when we use the remaining component. On the other hand, if the information edge is about the borrowing firms in general, we would expect to see the opposite pattern.

[20] To construct the variable *ADV violation*, in columns (1) and (2) of Table 6, we use responses to questions A, B, C, D, and H of Item 11 in Form ADV, while in columns (3) and (4) of Table 6, we use responses to questions C, D, and H of Item 11. Note that questions A and B are on criminal violations, questions C and D are on regulatory violations (e.g., the SEC, Commodity Trading Futures Commission, other federal regulatory agency, or state regulatory agency), and question H is on civil violations.

[21] In a related analysis, we also find that connected hedge funds' outperformance in loan stocks is larger when their prime broker banks are more prone to engage in misconduct, as measured by the total number of regulatory and civil event disclosures reported in the BrokerCheck Report from the Financial Industry Regulatory Authority (scaled by the bank's market capitalization). We report the results in Table IA.10 of the Internet Appendix.

[22] A number of prior studies, including Dennis and Mullineaux (2000); Ivashina (2009), and Ross (2010), use bond ratings as proxies for information asymmetry about a firm.

Table 7
Information asymmetry and performance of hedge fund trades.
This table reports the estimation results of Eq. (5) to examine whether the information advantage that hedge funds gain from their prime broker connections is related to information asymmetry about the borrowing firm. The dependent variable is trade returns, $\Delta Ownership_{i,j,t} \times Return_{j,t+1}$ (i.e., the product of hedge fund company i's portfolio weight change in stock j in quarter t and the subsequent quarter stock abnormal return). $Return_{j,t+1}$ is either the cumulative Carhart (1997) four-factor alpha or DGTW-adjusted return for stock j over the quarter $t + 1$. The indicator variable *Loan* is defined the same way as in Table 2. In Panel A, information asymmetry is measured by borrowing firm's credit rating. The indicator variable, *Unrated/Speculative*, equals one when a borrowing firm either does not have a rating or has a speculative rating and zero otherwise. In Panel B, information asymmetry is measured by the number of lead arrangers in the syndicate. The variable, *Sole lead*, equals one when a loan has exactly one lead arranger and zero otherwise. Standard errors are adjusted for heteroskedasticity and are three-way clustered by fund company, stock, and quarter, and t-statistics are reported below the coefficients in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

Panel A. Credit rating

	(1) Four-factor alpha × ΔOwnership	(2) DGTW × ΔOwnership
Loan × Speculative/Unrated	0.306**	0.232*
	(2.29)	(1.79)
Loan	0.101	0.097
	(1.28)	(1.19)
Fund comp. × Qtr. FE	Yes	Yes
Stock × Qtr. FE	Yes	Yes
Observations	1,748,255	1,746,357
Adj. R-squared	0.049	0.050

Panel B. Sole lead

	(1) Four-factor alpha × ΔOwnership	(2) DGTW × ΔOwnership
Loan × Sole lead	0.273**	0.282*
	(1.99)	(1.87)
Loan	0.152**	0.112*
	(2.46)	(1.85)
Fund comp. × Qtr. FE	Yes	Yes
Stock × Qtr. FE	Yes	Yes
Observations	1,748,255	1,746,357
Adj. R-squared	0.035	0.035

We present the results from these tests in Table 8. Columns (1) and (2) contain the results when trade performance is calculated using the three-day CAR around loan announcement, and columns (3) and (4) contain the results using the quarterly return minus the three-day CAR.[24] In columns (1) and (2), the coefficients on *Loan* are 0.038 and 0.035 for *Alpha* and *DGTW*, respectively, and are both statistically significant at the 1% level. In columns (3) and (4), the coefficients on *Loan* are 0.253 and 0.209 for *Alpha* and *DGTW*, respectively, and are both statistically significant at the 1% level. Thus, a significant portion of the outperformance of connected funds' trades in borrowing firms comes from the remaining quarter beside the loan announcement window. Note that the sum of the coefficients on the loan announcement CAR and the remaining component equals the corresponding coefficient of our baseline result in Table 2. This set of results suggests that connected hedge funds' information edge is not only about the loan but also about the borrowing firm in general.

4.4.2. What kind of information do connected hedge funds have about borrowing firms?

The results in the section above suggest that connected hedge funds are more informed about borrowing firms' fundamentals before loan announcements. The fact that this information advantage gets reflected in their trade performance over the next quarter suggests that some of the private information is revealed to the market and is incorporated in the stock price during the loan announcement quarter. Hence, we expect trades in treated stocks by connected hedge funds to earn greater profits when there is more value relevant fundamental information on the borrowing firm that subsequently gets disseminated to the market. In this section, we use earnings surprises and the intensity of 8-K filings to proxy for the dissemination of fundamental information to the market.

Part of the information that a lead arranger may receive during due diligence is financial projections such as forecasted earnings from the borrowing firm. If hedge fund clients of the bank gain such information, we expect these funds to earn greater profits on trades of treated stocks

[23] We find qualitatively similar results when we use the number of lenders in the syndicate to measure information asymmetry.

[24] Our results are similar if we use a five- or seven-day window to measure the loan announcement return (see Table IA.11 of the Internet Appendix).

Table 8
Information content: loan versus firm.
This table reports results of our investigation of whether the information that connected hedge funds have is specifically about the loan or the firm in general. To test this idea, we repeat the analysis in columns (2) and (3) of Table 2 except that we either use (i) the three-day loan announcement return of the treated stock or (ii) the quarterly return minus the three-day loan announcement return as our measure of abnormal return. For the alpha measure, the three-day CAR is computed using the four-factor model using the three days around the loan initiation date, while for the DGTW measure, we calculate the three-day CAR as cumulative stock return minus cumulative DGTW portfolio return for those three days. The dependent variable is trade performance, measured by the product of hedge fund company *i*'s portfolio weight change in stock *j* in quarter *t* and the subsequent quarter stock abnormal return (either the cumulative Carhart four-factor alpha or DGTW-adjusted return). The indicator variable *Loan* is defined the same way as in Table 2. Standard errors are adjusted for heteroskedasticity and are three-way clustered by fund company, stock, and quarter, and *t*-statistics are reported below the coefficients in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

	Loan announcement CARs		Quarterly return minus CARs	
	(1) Alpha × ΔOwnership	(2) DGTW × ΔOwnership	(3) Alpha × ΔOwnership	(4) DGTW × ΔOwnership
Loan	0.038***	0.035***	0.253***	0.209***
	(3.78)	(3.36)	(3.27)	(2.77)
Fund comp. × Qtr. FE	Yes	Yes	Yes	Yes
Stock × Qtr. FE	Yes	Yes	Yes	Yes
Observations	1,748,255	1,746,357	1,748,255	1,746,357
Adj. R-squared	0.087	0.090	0.031	0.032

that subsequently have large earnings surprises. To test this idea, we follow the literature (e.g., Livnat and Mendenhall, 2006) and construct a variable, standardized unexpected earnings, to measure earnings surprise. This measure is defined as actual earnings minus expected earnings (i.e., the median analyst forecast), scaled by the stock price. We then estimate the regression in Eq. (4), where $I_{j,t}$ represents an indicator variable that equals one if the absolute earnings surprise of a treated stock is in the top quartile of the loan sample and zero otherwise.

We report the results of these tests in Panel A of Table 9. The results support our conjecture. Connected hedge funds earn 0.430 and 0.388 bps more on their trades of treated stocks that have large earnings surprises during the loan announcement quarter. Both coefficients on the interaction term are statistically significant at the 5% level. Because we include stock × quarter fixed effects in the regressions, our analysis explores variation within each stock-quarter. Thus, our results show that connected hedge funds make more profitable trades on loan stocks in which there are larger earnings surprises compared to nonconnected funds that also trade these stocks. This evidence suggests that the information advantage of connected hedge funds is related to future earnings of the borrowing firm.

Our next set of tests uses firms' 8-K filings to examine the type of information that hedge funds may be receiving from their prime broker banks. Firms are required by the SEC to file an 8-K to announce certain material corporate events to shareholders. To quantify the intensity of informational events of a firm in a given quarter, we calculate two measures of information intensity based on the firm's 8-K filings (e.g., Zhao, 2017; Cooper et al., 2018): one based on the total number of 8-K filings and the other based on the total file size of 8-K filings.[25] The intuition is that quarters in which firms file an abnormally high number of or abnormally long 8-Ks are quarters in which firms disclose more material information to the market. If these information intensive quarters coincide with the quarter of a loan announcement, then we expect that the lead arranger of the loan would uncover more nonpublic information during due diligence and their connected hedge funds may enjoy a larger information advantage about the borrowing firm.

To test this idea, we estimate the regression in Eq. (5), where $I_{j,t}$ represents an indicator variable that equals one if our abnormal 8-K filings measure is in the top quartile of the loan sample and zero otherwise. Panel B of Table 9 contains the results of these tests. We find that, across all four columns, the coefficients on the interaction term are positive and statistically significant at the 10% level or better. The magnitude of the coefficients ranges from 0.249 to 0.542. This evidence suggests that connected hedge funds gain information about subsequent events that the borrowing firms deem to be materially important enough to disclose to the market.

In an additional analysis, we directly test whether connected hedge funds can front-run observable information events (i.e., using hedge fund holding changes to predict future earnings surprise or disclosure intensity of loan stocks).[26] We find that connected funds' trades before loan announcements significantly predict subsequent earnings surprises or 8-K disclosure intensity, but nonconnected funds' trades do not have any predictive power, with the difference between the two coefficients being statistically significant (see Table IA.12 of the Internet Appendix). This evidence further supports that connected funds' informa-

[25] We also find similar results if we construct the total file size variable based on the total number of items disclosed in all 8-K filings of a firm in a quarter.

[26] Specifically, for each loan stock, we split our sample of hedge fund holding changes into two groups, connected funds and nonconnected funds, and calculate the total net shares traded by each group. We then regress earnings surprises of loan stocks on (i) the total net shares traded by connected fundss and (ii) the total net shares traded by nonconnected funds, both scaled by the stock's shares outstanding. For the 8-K information intensity variables that do not have a positive or negative return direction, we use the absolute value of the total net shares traded by connected versus by nonconnected funds (both scaled by shares outstanding) as regressors.

Table 9
What type of information do connected hedge funds have?
This table reports the estimation results of Eq. (5) to examine what types of information funds are getting from their prime broker connections. The dependent variable is trade returns, $\Delta Ownership_{i,j,t} \times Return_{j,t+1}$ (i.e., the product of hedge fund company *i*'s portfolio weight change in stock *j* in quarter *t* and the subsequent quarter stock abnormal return). $Return_{j,t+1}$ is either the cumulative Carhart (1997) four-factor alpha or DGTW-adjusted return for stock *j* over the quarter $t + 1$. The indicator variable *Loan* is defined the same way as in Table 2. In Panel A, the variable of interest is *Large earnings surprise*, an indicator variable that equals one for loan-quarter observations where absolute earnings surprise during the quarter is in the top quartile of the sample, and zero otherwise. In Panel B, the variable of interest is *8-K intensity*. This indicator variable equals one if the borrowing firm files i) an unusually higher number of 8-K forms in a given quarter or ii) the 8-K filings are unusually large in size, compared to the corresponding time-series average of the firm. Standard errors are adjusted for heteroskedasticity and are three-way clustered by fund company, stock, and quarter, and *t*-statistics are reported below the coefficients in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

Panel A. Earnings surprise

	(1) Four-factor alpha × ΔOwnership	(2) DGTW × ΔOwnership
Loan × Large earnings surprise	0.430**	0.388**
	(2.16)	(2.09)
Loan	0.170**	0.170**
	(2.52)	(2.25)
Fund comp. × Qtr. FE	Yes	Yes
Stock × Qtr. FE	Yes	Yes
Observations	1,748,255	1,746,357
Adj. R-squared	0.056	0.126

Panel B. 8-K filings

	# 8-K filings		8-K filing size	
	(1) Alpha × ΔOwnership	(2) DGTW × ΔOwnership	(3) Alpha × ΔOwnership	(4) DGTW × ΔOwnership
Loan × 8-K intensity	0.339**	0.542***	0.249*	0.302**
	(2.02)	(3.32)	(1.83)	(2.16)
Loan	0.193**	0.130	0.143*	0.101
	(2.20)	(1.30)	(1.98)	(1.36)
Fund comp. × Qtr. FE	Yes	Yes	Yes	Yes
Stock × Qtr. FE	Yes	Yes	Yes	Yes
Observations	1,748,255	1,746,357	1,748,255	1,746,357
Adj. R-squared	0.033	0.034	0.042	0.042

tion edge is in part regarding future earnings and information contained in 8-K filings.

4.4.3. Positive versus negative information

One natural question that arises is whether abnormal trading profits of connected hedge funds we show in this paper are driven by positive or negative information. To answer this question, we divide our full sample into two subsamples based on the sign of abnormal stock returns during the quarter of the loan announcement (positive versus negative) and then repeat our main analysis in Table 2 over each subsample. If connected funds have an edge on positive (negative) information of borrowing firms, we should find evidence of outperformance by connected funds among the subsample of stocks with positive (negative) abnormal returns.

We report the results of this analysis in Table 10. For both positive and negative return subsamples, we find evidence of outperformance by connected hedge funds.[27] The coefficient estimates for both subsamples are similar, both economically and statistically, to the corresponding coefficient in our main analysis in Table 2. This result suggests that connected hedge funds gain an edge from their prime broker bank on both positive and negative information about the borrowing firm. This evidence is consistent with the idea that banks have incentives to assess both the upside and downside scenarios when screening borrowers.

For completeness, we also test our main hypothesis using hedge funds' option holdings data, as funds can use derivatives markets to trade on nonpublic information. Analyzing option trades also help address the limitation that the 13F equity holding data do not allow us to observe short positions as funds betting against a stock could potentially buy put options. We describe the analysis using 13F equity option holdings data in Part A of the Internet Appendix and present the results in Table IA.13 of the Internet Appendix. We find that connected hedge funds' trades in call options of loan stocks outperform other trades in call options, though connected hedge funds' trades of put options of loan stocks do not exhibit any significant outperformance. This evidence provides further evidence that connected hedge funds gain an informational advantage from their prime broker banks.

4.4.4. Analyst coverage inside the prime broker bank

In this section, we analyze one potential channel of information transmission: equity analysts inside the bank.

[27] We find similar results if we carry out the analysis over the full sample and interact the variable *Loan* with two dummy variables for positive and negative abnormal stock returns.

Table 10
Information advantage: positive versus negative information.
This table contains the results for the subsample analysis examining whether the information advantage that hedge funds gain from their prime broker connections is driven by positive or negative information. We divide our full sample into two subsamples based on the sign of abnormal stock returns (positive versus negative) and then repeat our main analysis in Table 2 over each subsample. The dependent variable in both panels is trade returns defined as the product of hedge fund company *i*'s portfolio weight change in stock *j* in quarter *t* and the subsequent quarter stock abnormal return. $Return_{j,t+1}$ is either the cumulative Carhart (1997) four-factor alpha or DGTW-adjusted return for stock *j* over the quarter $t + 1$. Standard errors are adjusted for heteroskedasticity and are three-way clustered by fund company, stock, and quarter, and *t*-statistics are reported below the coefficients in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

	Positive abnormal returns		Negative abnormal returns	
	(1) Alpha × ΔOwnership	(2) DGTW × ΔOwnership	(3) Alpha × ΔOwnership	(4) DGTW × ΔOwnership
Loan	0.304***	0.253**	0.282***	0.235**
	(2.76)	(2.19)	(2.80)	(2.56)
Fund comp. × Qtr. FE	Yes	Yes	Yes	Yes
Stock × Qtr. FE	Yes	Yes	Yes	Yes
Observations	848,588	846,800	899,614	899,511
Adj. R-squared	0.062	0.064	0.058	0.057

It has been shown in the prior literature that equity analysts of the lead arranger of a loan appear to possess nonpublic information about the borrowing firm (e.g., Chen and Martin, 2011). In addition, anecdotal evidence suggests that prized hedge fund clients could gain special access to equity analysts of the prime broker bank (e.g., Morgenson, 2012). If equity analysts are a conduit of information transfer, we expect connected funds to enjoy a larger information edge when their prime broker bank also has an analyst covering the borrowing firm.

To test this hypothesis, we obtain information from the Institutional Brokers' Estimate System (I/B/E/S) about the stocks that the analysts at each prime broker bank cover in a given quarter. We then create an indicator variable, *Analyst*, to capture cases where the lead bank during the loan event also has an analyst covering the borrowing firm's stock and zero otherwise.[28] We estimate the following regression:

$$y_{i,j,t} = \beta_1 * Loan_{i,j,t} * Analyst_{i,j,t} + \beta_2 * Loan_{i,j,t} + \gamma_{i,t} + \kappa_{j,t} + \eta_{i,j,t}, \quad (6)$$

where the dependent variable is trade performance described earlier; $Analyst_{i,j,t}$ represents an indicator variable that equals one if hedge fund *i*'s prime broker bank is a lead arranger for a loan to firm *j* and also has an equity analyst covering firm *j* in quarter *t* and zero otherwise; $\gamma_{i,t}$ represents fund company × quarter fixed effects; and $\kappa_{j,t}$ represents stock × quarter fixed effects.

We present the estimation results in Table 11. Consistent with our hypothesis, the coefficients on *Loan* × *Analyst* are positive (0.402 and 0.383, respectively) and are statistically significant at the 5% level in both specifications. That is, connected hedge funds enjoy a much larger information advantage about the borrowing firm when their lead prime broker bank also has an analyst covering the same firm. These results provide evidence that the equity analyst division is one potential conduit of information transfer between the prime broker bank and its hedge fund clients. It is important to note that the coefficient on *Loan* remains positive and statistically significant, which suggests that connected funds still gain an information advantage when there is no in-house analyst covering the borrower. Thus, there are likely other potential channels of information transmission besides equity analysts inside the prime broker bank. For instance, as we discuss in Section 4.5, connected funds can also interact with other bank employees who may possess nonpublic information at events such as private meetings, invitation-only conferences, and social events.

4.5. Discussion

Our empirical evidence demonstrates that hedge funds have an information advantage when their prime broker banks serve as lead arrangers for a loan. It is important to discuss the institutional setting and the economics of such arrangements.

Hedge funds have a unique relationship with their prime broker banks. Hedge funds that pay a large amount of fees for prime brokerage services typically sit at the top of the bank's client pyramid and receive preferential treatment from the bank (e.g., Enrich and Cimilluca, 2011; Morgenson, 2012). This arrangement is similar to brokerage firms providing additional services (e.g., equity research) to institutional clients that pay higher trading commissions (e.g., Irvine et al., 2007; Goldstein et al., 2009). Investment banks have strong incentives to attract and retain lucrative hedge fund clients. Anecdotal evidence suggests hedge funds generate more than $10 million in annual investment banking revenue for every billion dollars that the funds have under management (Lux, 2002). In addition, funds typically have more than one prime broker and can change the share of their business they allocate to a particular prime broker bank (i.e., share of wallet) if they are unsatisfied with the services that the broker is providing. Hedge funds could use the threat of reallocating a portion of their business to a different broker to obtain preferential access to valuable resources. Due to these incentives, banks often provide hedge fund clients special access to broader resources and services of the banks, such as equity research analysts, key banking

[29] About 12% of the connected loan observations are cases in which the stock is simultaneously covered by an analyst at the prime broker bank.

Table 11
Equity research analyst as a channel of information transfer.
This table reports the estimation results of Eq. (6) to examine whether the information advantage that hedge funds gain from their prime broker connections is higher when there is an analyst covering the stock at the fund's prime broker bank. The dependent variable is trade returns, $\Delta Ownership_{i,j,t} \times Return_{j,t+1}$ (i.e., the product of hedge fund company *i*'s portfolio weight change in stock *j* in quarter *t* and the subsequent quarter stock abnormal return). $Return_{j,t+1}$ is either the cumulative Carhart (1997) four-factor alpha or DGTW-adjusted return for stock *j* over the quarter $t + 1$. The indicator variable *Loan* is defined the same way as in Table 2. *Analyst* is an indicator variable that equals one if hedge fund *i*'s prime broker bank is a lead arranger for a loan to firm *j* and that bank also has an equity research analyst covering firm *j* in quarter *t* and zero otherwise. Standard errors are adjusted for heteroskedasticity and are three-way clustered by fund company, stock, and quarter, and *t*-statistics are reported below the coefficients in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

	(1) Four-factor alpha × ΔOwnership	(2) DGTW × ΔOwnership
Loan × Analyst	0.402**	0.383**
	(2.35)	(2.18)
Loan	0.121***	0.084**
	(2.88)	(2.06)
Fund comp. × Qtr. FE	Yes	Yes
Stock × Qtr. FE	Yes	Yes
Observations	1,748,255	1,746,357
Adj. R-squared	0.031	0.032

personnel, and invitation-only meetings.[29] These sources could be valuable to information-hungry hedge funds who strive for any information edge over other investors.

Next, we discuss the implications of the information flow we show for various entities involved. Under insider trading laws, it is illegal to buy or sell securities based on material nonpublic information (MNPI). In the context of our setting, the appropriateness of information transfer from banks to hedge funds depends on whether MNPI changes hands and is subsequently traded upon. If the information shared is material and not publicly available, our evidence of outperformance by connected funds would suggest a violation of insider trading laws. However, it is also possible that connected hedge funds obtain information that is nonmaterial on its own but becomes valuable once combined with other information these funds already possess. For instance, hedge funds can combine pieces of information (material or nonmaterial) obtained from various sources to gain a deeper understanding of a specific company, thereby generating profitable trading signals. Such an interpretation would be in line with the evidence in the literature that hedge funds are better at processing information (e.g., Solomon and Soltes, 2015). Under this scenario, investment banks' provision of preferential treatment to hedge funds could be within the legal boundary and our evidence would not suggest a violation of insider trading laws.

Our findings also have implications for policymakers and regulators. First, from the perspective of stock market integrity, shareholders of the borrowing firms are harmed by hedge funds enjoying an unfair, if not illegal, information advantage due to their connections to prime broker banks. This should raise concerns for regulators. Second, our findings suggest that banks with both commercial lending and prime brokerage divisions can capitalize on the valuable information they possess about their corporate clients through their prime brokerage business. This evidence implies a potential distortion in the universal banking model, which adds to the debate on bank deregulation (e.g., on the repeal of the Glass-Steagall Act of 1933).

5. Conclusion

Prime brokers' traditional roles to hedge funds include providing financing, trade execution, and custody services. In this paper, we show a new value-adding function that prime broker banks provide to their hedge fund clients: an information advantage regarding the banks' corporate clients. We use the setting of loan originations to identify the possession of nonpublic information by banks and test whether hedge funds gain an information advantage from the unique relationship they have with their prime broker banks. Consistent with our hypothesis, we find that hedge funds make informed trades on the stocks of firms that obtain loans from the funds' prime broker banks.

In particular, we find that connected hedge funds make abnormally large trades prior to loan announcements, and

[29] We provide anecdotal evidence from media reports in Part C of the Internet Appendix. For instance, referring to hedge funds' preferential access to research analysts, a New York Times article reports, "Some of the nation's biggest brokerage firms appear to be giving a handful of top hedge funds an early peek at these sentiments" (Morgenson, 2012). The sentiments here refer to changes in research analysts' recommendations for specific stocks. The article further goes on to say, "As one of the largest payers of trading commissions to Wall Street, BlackRock is a client that brokerage firms want to please to keep those commissions flowing." Describing a typical invitation-only meeting, an article in Institutional Investor states, "Morgan Stanley & Co. kicked off its invitation-only hedge fund conference in January with a dinner at the Breakers Hotel in Palm Beach…a who's who of investors in the secretive hedge fund world awaited a presentation on stocks by the firm's stock market strategist, Byron Wien" (Lux, 2002). Similarly, highlighting the special access that hedge funds have to key banking personnel, an article in The Wall Street Journal states, "Investment banks vie for business from elite hedge funds by offering traders at those funds special access to senior deal makers and corporate executives at dinners and other gatherings…Banks try to differentiate themselves from rivals by dangling access to key players—coveted by hedge funds, for which incremental bits of information can be extremely valuable" (Enrich and Cimilluca, 2011).

these trades subsequently generate superior performance compared to other trades. In dollar terms, this outperformance translates to $401,600–$479,000 in abnormal profits per quarter for an average connected hedge fund company in our sample. Furthermore, the outperformance is particularly strong for (i) trades of connected hedge funds with high revenue generation potential for prime broker banks and (ii) trades in stocks of borrowing firms that obtain a loan from the fund's prime broker bank for the first time or have high information asymmetry. In contrast, this information advantage is not present for hedge funds whose prime broker banks participate in loans but do not perform the role of a lead arranger. Further analysis suggests that the information edge connected hedge funds have appears to be based on fundamental information about the borrowing firm such as its future earnings as well as information specifically about the loan. Finally, our evidence suggests that equity analysts inside the bank represent one potential conduit of information transfer.

Our evidence of informed trading ahead of loan announcements is consistent with MNPI flow from prime broker banks to their hedge fund clients. It is also possible that the information shared is nonmaterial on its own but becomes valuable once combined with other information signals that these connected hedge funds have. Regardless of the source of the information advantage by connected hedge funds, our analysis uncovers that prime broker banks provide a valuable function of information brokerage to hedge fund clients.

References

Acharya, V., Johnson, T., 2007. Insider trading in credit derivatives. J. Financ. Econ. 84, 110–141.

Agarwal, V., Jiang, W., Tang, Y., Yang, B., 2013. Uncovering hedge fund skill from the portfolio holdings they hide. J. Financ. 68, 739–783.

Agarwal, V., Naik, N.Y., 2000. Multi-period performance persistence analysis of hedge funds. J. Financ. Quant. Anal. 35, 327–342.

Aggarwal, R.K., Jorion, P., 2010. The performance of emerging hedge funds and managers. J. Financ. Econ. 96, 238–256.

Aragon, G.O., Martin, J.S., 2012. A unique view of hedge fund derivatives usage: safeguard or speculation? J. Financ. Econ. 105, 436–456.

Aragon, G.O., Strahan, P.E., 2012. Hedge funds as liquidity providers: evidence from the Lehman bankruptcy. J. Financ. Econ. 103, 570–587.

Ben-David, I., Franzoni, F., Moussawi, R., Sedunov, J., 2016. The Granular Nature of Large Institutional Investors. National Bureau of Economic Research Unpublished working paper.

Boyson, N.M., Stahel, C.W., Stulz, R.M., 2010. Hedge fund contagion and liquidity shocks. J. Financ. 65, 1789–1816.

Brown, S.W., Goetzmann, W., Ibbotson, R., 1999. Offshore hedge funds: survival and performance 1989–1995. J. Bus. 72, 91–117.

Brown, S.W., Goetzmann, W., Liang, B., Schwarz, C., 2008. Mandatory disclosure and operational risk: evidence from hedge fund registration. J. Financ. 63, 2785–2815.

Brown, S.W., Lu, Y., Ray, S., Teo, M., 2018. Sensation seeking and hedge funds. J. Financ. 73, 2871–2914.

Brunnermeier, M., Nagel, S., 2004. Hedge funds and the technology bubble. J. Financ. 59, 2013–2040.

Carhart, M., 1997. On persistence in mutual fund performance. J. Financ. 52, 57–82.

Chava, S., Roberts, M., 2008. How does financing impact investment? The role of debt covenants. J. Financ. 63, 2085–2121.

Chen, T., Martin, X., 2011. Do bank-affiliated analysts benefit from lending relationships? J. Account. Res. 49, 633–675.

Chung, J., Kang, B., 2016. Prime broker-level comovement in hedge fund returns: information or contagion? Rev. Financ. Stud. 29, 3321–3353.

Cooper, M.J., He, J., Plumlee, M.A., 2018. Measuring Disclosure Using 8-K Filings. University of Utah and University of Delaware Unpublished working paper.

Coval, J., Moskowitz, T., 2002. Home bias at home: local equity preference in domestic portfolios. J. Financ. 54, 2045–2073.

Daniel, K., Grinblatt, M., Titman, S., Wermers, R., 1997. Measuring mutual fund performance with characteristic-based benchmarks. J. Financ. 52, 1035–1058.

Demiroglu, C., James, C., 2010. The information content of bank loan covenants. Rev. Financ. Stud. 23, 3700–3737.

Dennis, S., Mullineaux, D., 2000. Syndicated loans. J. Financ. Intermed. 9, 404–426.

Di Maggio, M., Franzoni, F., Kermani, A., Sommavilla, C., 2019. The relevance of broker networks for information diffusion in the stock market. J. Financ. Econ. 134, 419–446.

Enrich, D., Cimilluca, D., 2011. Banks woo funds with private peeks. The Wall Street Journal. https://www.wsj.com/articles/SB10001424052748703841904576256520217477678

Fama, E.F., 1985. What's different about banks? J. Monet. Econ. 15, 29–39.

Fama, E.F., French, K.R., 1993. Common risk factors in the returns on stocks and bonds. J. Financ. Econ. 33, 3–56.

Gargano, A., Rossi, A.G., Wermers, R., 2017. The freedom of information act and the race toward information acquisition. Rev. Financ. Stud. 30, 2179–2228.

Gao, M., Huang, J., 2016. Capitalizing on capitol hill: informed trading by hedge fund managers. J. Financ. Econ. 121, 521–545.

Goldstein, M.A., Irvine, P., Kandel, E., Wiener, Z., 2009. Brokerage commissions and institutional trading patterns. Rev. Financ. Stud. 22, 5175–5212.

Griffin, J.M., Shu, T., Topaloglu, S., 2012. Examining the dark side of financial markets: do institutions trade on information from investment bank connections? Rev. Financ. Stud. 25, 2155–2188.

Irvine, P., Lipson, M., Puckett, A., 2007. Tipping. Rev. Financ. Stud. 20, 741–768.

Ivashina, V., 2009. Asymmetric information effects in loan spreads. J. Financ. Econ. 92, 300–319.

Ivashina, V., Sun, Z., 2011. Institutional stock trading on loan market information. J. Financ. Econ. 100, 284–303.

Jagannathan, R., Malakhov, A., Novikov, D., 2010. Do hot hands exist among hedge fund managers? An empirical evaluation. J. Financ. 65, 217–255.

James, C., 1987. Some evidence on the uniqueness of bank loans. J. Financ. Econ. 19, 217–235.

Jegadeesh, N., Titman, S., 1993. Returns to buying winners and selling losers: implications for stock market efficiency. J. Financ. 48, 65–91.

Joenväärä, J., Kosowski, R., Tolonen, P., 2014. Hedge Fund Performance: What Do We Know. University of Oulu and Imperial College Unpublished working paper.

Jorion, P., Schwarz, C., 2014. The strategic listing decisions of hedge funds. J. Financ. Quant. Anal. 49, 773–796.

Klaus, B., Rzepkowski, B., 2009. Hedge Funds and Prime Brokers: The Role of Funding Risk. Goethe University Frankfurt Unpublished working paper.

Klein, A., Li, T., 2015. Acquiring and Trading on Complex Information: How Hedge Funds Use the Freedom of Information Act. New York University Unpublished working paper.

Kosowski, R., Naik, N.Y., Teo, M., 2007. Do hedge funds deliver alpha? A Bayesian and bootstrap analysis. J. Financ. Econ. 84, 229–264.

Liberti, J.M., Petersen, M.A., 2018. Information: hard and soft. Rev. Corp. Financ. Stud. 8, 1–41.

Livnat, J., Mendenhall, R.M., 2006. Comparing the post-earnings announcement drift for surprises calculated from analyst and time series forecasts. J. Account. Res. 44, 177–205.

Lux, H., 2002. Who wants to be a billionaire? Institutional Investor. https://www.institutionalinvestor.com/article/b151357cb68f51/who-wants-to-be-a-billionaire

Lynn, M., 2005. Investment banks are too dependent on hedge funds. Bloomberg News. https://www.bloomberg.com/news/articles/2005-03-21/investment-banks-are-too-dependent-on-hedge-funds-matthew-lynn

Massa, M., Rehman, Z., 2008. Information flow within financial conglomerates: evidence from the banks-mutual funds relationship. J. Financ. Econ. 89, 288–306.

Massoud, N., Nandy, D., Saunders, A., Song, K., 2011. Do hedge funds trade on private information? Evidence from syndicated lending and short-selling. J. Financ. Econ. 99, 477–499.

Morgenson, G., 2012. Surveys give big investors an early view from analysts. The New York Times. https://www.nytimes.com/2012/07/16/business/in-surveys-hedge-funds-see-early-views-of-stock-analysts.html

Mullally, K.A., 2016. Outside Ownership in the Hedge Fund Industry. University of Central Florida Unpublished working paper.

Murfin, J., Petersen, M., 2016. Loans on sale: credit market seasonality, borrower need, and lender rents. J. Financ. Econ. 121, 300–326.
Petersen, M.A., Rajan, R.G., 1994. The benefits of lending relationships: evidence from small business data. J. Financ. 49, 3–37.
Pool, V.K., Stoffman, N., Yonker, S., 2015. The people in your neighborhood: social interactions and mutual fund portfolios. J. Financ. 70, 2679–2733.
Qian, H., Zhong, Z., 2018. Do hedge funds possess private information in IPO stocks? Evidence from post-IPO holdings. Rev. Asset Pricing Stud. 8, 117–152.
Rajan, R.G., 1992. Insiders and outsiders: the choice between informed and arm's-length debt. J. Financ. 47, 1367–1400.
Ross, D., 2010. The "dominant bank effect:" how higher lender reputation affects the information content and terms of bank loans. Rev. Financ. Stud. 23, 2730–2756.
Solomon, D., Soltes, E., 2015. What are we meeting for? The consequences of private meetings with investors. J. Law Econ. 58, 325–355.
Sufi, A., 2007. Information asymmetry and financing arrangements: evidence from syndicated loans. J. Financ. 62, 629–668.
Sun, Z., Wang, A., Zheng, L., 2012. The road less traveled: strategy distinctiveness and hedge fund performance. Rev. Financ. Stud. 25, 96–143.
Taylor, A., Sansone, A., 2007. The Handbook of Loan Syndication and Trading. McGraw-Hill, New York.
Teo, M., 2009. The geography of hedge funds. Rev. Financ. Stud. 22, 3531–3561.
Zhao, X., 2017. Does information intensity matter for stock returns? Evidence from form 8-K filings. Manag. Sci. 63, 1382–1404.