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Dan Li, Phillip J. Monin, and Lubomir Petrasek

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Credit Supply and Hedge Fund Performance: Evidence from Prime Broker Surveys

Dan Li, Phillip J. Monin, and Lubomir Petrasek*

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Abstract

Constraints on the supply of credit by prime brokers affect hedge funds' leverage and performance. Using dealer surveys and hedge fund regulatory filings, we identify individual funds' credit supply from the availability of credit under agreements currently in place between a hedge fund and its prime brokers. We find that hedge funds connected to prime brokers that make more credit available to their hedge fund clients increase their borrowing and generate higher returns and alphas. These effects are more pronounced among hedge funds that rely on a small number of prime brokers, and those that rely on borrowing rather than derivatives for their leverage. Credit supply matters more for hedge fund performance during periods of financial market stress and when trading opportunities are abundant.

Keywords: Hedge funds, dealers, leverage, prime brokerage, financing, surveys

JEL: G23

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1 Introduction

Hedge fund trades often exploit small price differences between correlated assets and require significant leverage to be viable. This leverage is predominantly supplied by a fund's prime brokers, making the availability of prime brokerage credit, or a lack thereof, a significant source of risk for hedge funds. Moreover, at the market level, hedge funds' funding constraints can lead to liquidity spirals theorized by Brunnermeier and Pedersen (2009). Many hedge funds see these leverage risks as material, warranting disclosure to investors:

> "The strategies' use of leverage may depend on the availability of leverage or credit in order to finance their portfolios...There can be no assurance that Bridgewater will be able to maintain adequate financing arrangements under all market circumstances. As a general matter, banks and dealers that provide financing to the strategies can apply essentially discretionary margin, haircut, financing, security, and collateral valuation policies. The financing available to the strategies from banks, dealers, and counterparties is likely to be restricted in disrupted markets...Any such adverse effects may be exacerbated in the event that such limitations or restrictions are imposed suddenly and/or by multiple market participants at or about the same time."[1]

Despite its importance for hedge funds and broader financial markets, little is known about how the availability of credit affects hedge funds' use of leverage and the profitability of hedge fund trading. Ang, Gorovyy, and van Inwegen (2011) analyze hedge funds' use of leverage in the time-series and cross-section. They show that the use of leverage by hedge funds depends in part on macroeconomic variables such as funding spreads that proxy for its availability. Changes in leverage are also affected by factors that proxy for investment opportunities and demand for for financing, such as increases in market values.

However, since the use of leverage depends on both its supply and demand, changes in the supply of leverage are difficult to identify from the observed use of leverage. We overcome this difficulty by studying new data on the availability of leverage to hedge funds from prime brokerage surveys. Specifically, the Senior Credit Officer Opinion Survey (SCOOS) collects quarterly information from prime brokers on the availability of additional (and currently unutilized) financial leverage under agreements currently in place with hedge funds. We combine the survey data with information on hedge fund-prime broker connections from hedge funds' regulatory disclosures (Form PF and Form ADV) and analyze the effects of changes in the availability of leverage on the use of leverage and performance of the connected hedge funds. To our knowledge, this is the first paper systematically analyzing the effects of credit supply on hedge funds.

[1] Form ADV, Bridgewater Associates, LP, October 10, 2022.

We find that credit supply affects hedge funds' use of leverage and performance. Hedge funds connected to prime brokers that increase/decrease the availability of additional leverage to their hedge fund clients subsequently increase their borrowing and significantly outperform their peers on a risk-adjusted basis. These effects are more pronounced among hedge funds that rely on a small number of prime brokers or trading counterparties, and those that rely on borrowing rather than derivatives for their leverage. In addition, we find that these supply effects are particularly pronounced during periods when the availability of leverage is likely to be constrained, such as periods with high dealer funding costs and CDS spreads, high interest rate volatility and low stock market returns. The availability of leverage also matters more for hedge funds' ability to generate alpha when trading opportunities are abundant, as measured by elevated relative-value spreads in equity, Treasury, and corporate bond markets.

Our findings provide empirical support for models of leverage and margin constraints (Black, 1972; Gârleanu and Pedersen, 2011; Frazzini and Pedersen, 2014; Hugonnier and Prieto, 2015). These models imply a positive relationship between the supply of leverage and the alpha generated by a leveraged investor. Black (1972) shows that investors' borrowing constraints result in a flatter relation between betas and expected returns than if borrowing is unconstrained. In the model of Frazzini and Pedersen (2014), investors with unconstrained access to leverage hold less risky underlying portfolios with higher alphas and use leverage to amplify returns. Relatively more constrained investors use less leverage and hold riskier assets that generate lower alpha. Hugonnier and Prieto (2015) provides a model of leverage arbitrage, in which arbitraguers amplify fundamental shocks by levering up in good times and deleveraging in bad time. Our data allow us to directly test these theories using differences across hedge funds in the availability of leverage from the connected prime brokers.

Our paper also sheds light on previous findings in the literature regarding the co-movement in hedge fund returns. Boyson, Stahel, and Stulz (2010) find evidence that the worst hedge fund returns cluster across investment strategies, and the probability of such "contagion" increases with adverse shocks to credit spreads, bank funding spreads, and prime broker and bank stock prices. Chung and Kang (2016) document strong co-movement in the returns across hedge funds sharing the same prime broker, suggesting that shocks to prime brokers transmit to hedge funds, but their findings do not support funding spillovers as the main transmission channel. Aragon and Strahan (2012) and Kruttli, Monin, and Watugala (2022) find that an idiosyncratic liquidity shock to one major prime broker transmits to the connected hedge funds. However, they also find that the affected hedge funds typically can substitute their funding away from the affected prime broker. Aside from prime broker distress, which is a credit risk event as well as a liquidity shock, the availability of leverage to hedge funds has proved difficult to measure. We contribute to this literature by studying the effects on hedge funds of the availability of leverage from prime brokers and other connected counterparties more broadly. Apart from distress or bankruptcy, prime brokers can adjust the availability of leverage to hedge funds for a number of reasons, including their own funding costs, regulatory constraints, availability of balance sheet capital, a strategic decision to compete with other prime brokers, or risk management considerations. On the other hand, even if they are under stress, prime brokers can be reluctant to pass on funding shocks or their own regulatory constraints to their hedge fund clients because they value client relationships and do not wish to lose potential future business (Kruttli, Monin, Petrasek, and Watugala, 2021). The survey measures we use capture the full range of circumstances in which prime brokers may change the supply of leverage to their hedge fund clients.

More broadly, our paper contributes to the literature on the leverage of financial intermediaries and their leverage constraints. For example, Ang, Gorovyy, and van Inwegen (2011) investigate the use of leverage by hedge funds, and compare it to the leverage of broker-dealers. Adrian and Shin (2014) show that the leverage of security broker-dealers is pro-cyclical, and Adrian, Etula, and Muir (2014) show that it can explain the excess returns on a variety of assets. Boguth and Simutin (2018) show that mutual fund leverage restrictions explain returns of the betting-against-beta (BAB) portfolio. Lu and Qin (2021) derive the shadow cost of leverage from the returns of leveraged exchange-traded funds and show that it positively predicts BAB returns. Subrahmanyam, Tang, Wang, and Yang (2024) analyze the interactions between derivative traders' skills, their implied leverage, and performance. Our findings demonstrate the effects of hedge fund leverage constraints on hedge fund borrowing and performance.

The rest of the paper is organized as follows. Section 2 describes and summarizes our data, including the Senior Credit Officer Opinion Survey (SCOOS), Form PF, and other data. Section 3 analyzes the relationship between survey-based measures of leverage availability and hedge fund borrowing and performance. The section also examines the effects of leverage availability to hedge funds in the cross-section and time-series, and analyzes the robustness of the results. Section 4 concludes.

2 Data

2.1 SCOOS

The Senior Credit Officer Opinion Survey (SCOOS) is a quarterly survey of primary dealers and other dealers active in over-the-counter securities and derivatives markets. The survey has been conducted by the Federal Reserve since 2011 to gauge the supply of credit to dealer counterparties. Specifically, the survey queries senior credit officers on changes in the financing terms and credit availability to different types of counterparties, including hedge funds. The institutions that participate in the survey account for a vast majority of the activities in these markets. For example, the 24 dealers that participate in the survey between 2011 and 2022 account for 91% of hedge fund borrowing during the period.

To measure the supply of leverage to hedge funds, we focus on the following question (question 9 in the current survey):

"Considering the entire range of transactions facilitated by your institution for such [your hedge fund] clients, how has the availability of additional (and currently unutilized) financial leverage under agreements currently in place with hedge funds (for example, under prime broker, warehouse agreements, and other committed but undrawn or partly drawn facilities) changed over the past three months?"

Importantly, question 9 asks about changes in the availability to hedge fund clients of currently utilized financial leverage leverage rather than hedge funds' use of leverage. Although leverage availability and its use both depend on supply factors, leverage availability abstracts from demand factors, such as those related to investment opportunities that are also affecting leverage use. The SCOOS questions are qualitative, with answers ranging from "increased considerably" to "decreased considerably" over the past three months. We code increases in leverage as "+1" and decreases as "-1".[2]

Figure 1 shows the percentage of participants of dealers who either increased or decreased the availability of leverage to their hedge fund clients, respectively. As the figure indicates, there is considerable variation among dealers in how much additional leverage they make available to hedge funds. On net, decreases tend to dominate increases during periods of market stress such as in Q1 2020, while the opposite is true during calm periods.

2.2 Form PF

We combine the data from the credit officer surveys with information from Form PF on individual hedge funds and their creditors. Form PF is a reporting form for investment advisers to private funds, and advisers to large hedge funds have been required to file the form with the SEC since late 2012.[3] Large hedge fund advisers with at least $1.5 billion in hedge fund assets under management are required to file Section 2a of Form PF, in which they provide quarterly information with respect to each qualifying hedge fund that they advise. Qualifying hedge funds are those with net assets of at least $500 million. We limit the sample to qualifying hedge funds.

[2] Our findings remain unchanged if we assign a greater value to "considerable" increases or decreases, which are rare.

[3] https://www.sec.gov/about/forms/formpf.pdf.

We use Form PF question 47 to connect the individual hedge funds with with creditor-level information from SCOOS surveys. Specifically, question 47 identifies by name each creditor to which the reporting fund owed an amount equal or greater than 5% of the fund's net asset value, and reports the borrowing amounts for these creditors. We use the borrowing amounts $Borrowing_{h,c,t-1}$ to calculate weights reflecting the strength of association between a hedge fund h and its creditor c. These weights are used to aggregate individual creditors' SCOOS responses to the hedge fund level. Specifically, SCOOS question 9 responses $Q9_{c,t}$ from each creditor c at time t are aggregated across creditors as follows:

$$\Delta LevAvail_{h,t} = \sum_{c=1}^{C} \frac{Borrowing_{h,c,t-1}}{Borrowing_{h,t-1}} Q9_{c,t}. \tag{1}$$

The variable $\Delta LevAvail_{h,t}$ measures change in the availability of leverage to hedge fund h at time t from all of its creditors $c = 1, \ldots, C$, as identified at time $t-1$. The creditor weights are lagged one quarter to avoid any interactions between the weights and the availability of leverage, such as hedge funds with greater demand for financing seeking to connect with creditors that make more financing available to their hedge fund clients at time t.

Our sample consists of quarterly observations on qualifying hedge funds that list one or more SCOOS respondent among their counterparties on Form PF question 47. Only 53% of the qualifying hedge fund records in form PF meet the 5% of net assets reporting threshold for at least one of their borrowing counterparties. The non-reporting funds typically do not borrow significantly, with median borrowing of less than 0.5% of NAV compared to over 60% for reporting funds.[4] The availability of leverage is therefore not likely to be an important concern for the non-reporting funds. Among the fund-quarters that contain at least one creditor counterparty on Form PF question 47, the average number of creditors is about 3. The vast majority of these funds have creditors that can be linked to SCOOS. SCOOS counterparties account for 91% of the borrowing volumes reported on Form PF question 47, indicating strong coverage of major hedge fund counterparties by SCOOS.

Besides creditor connections, we use data from Form PF on fund assets, portfolio exposures, borrowing, leverage, liquidity, and returns. Net asset asset value (NAV) corresponds to a fund's investment capital, and gross asset value (GAV) corresponds to its on-balance sheet assets. Gross notional exposure (GNE) includes the notional value of derivatives exposures in addition to on-balance sheet assets.[5] Borrowing is measured either as total borrowing ($TotBorrow$) or as secured borrowing ($SecBorrow$). Correspondingly, leverage is measured as total borrowing divided by NAV

[4] A hedge fund is defined in Form PF as any private fund that has the ability to pay a performance fee to its adviser, borrow in excess of a certain amount, or sell assets short, regardless their actual borrowing. This definition includes many funds with private equity and private-debt fund strategies that do not use significant leverage.

[5] Interest rate derivatives as measured at 10-year equivalents. Option exposures are delta-adjusted.

($LevTotBorrow$), secured borrowing divided by NAV ($LevSecBorrow$), or as GNE divided by NAV ($LevGNE$). Onwership concentration ($OwnConcent$) is measured by the ownership fraction of the top 5 beneficial owners. Institutional ownership ($InstitOwn$) is the ownership share of institutional investors of the funds' capital (NAV). The number of counterparties ($CounterCount$) is the number of borrowing counterparties reported in q. 47. Counterparty concentration ($CounterConcent$) is measured by the Herfindahl index of the borrowing fractions reported in q. 47. The number of prime brokers ($PBCount$) is as reported on Form ADV. Portfolio illiquidity ($PortIlliq$) is measured as the weighted average number of days it would take to liquidate a fund's portfolio, as reported on Form PF q. 32. Share restrictions ($ShareRestrict$) is the weighted average number of days within which investors are entitled to withdraw the invested funds, as reported on Form PF q. 50.

Returns are measured either net of fees ($NetRet$) or gross of fees ($GrossRet$) on a quarterly basis. If quarterly returns are not reported and monthly returns are reported, we compound the monthly returns into quarterly. In addition, we use the monthly net returns (if available) to estimate two measures of alpha. Our main measure is based on the seven factor model of Fung and Hsieh (2004). We also calculate the CAPM alpha, since Agarwal, Green, and Ren (2018) find that hedge fund investors put emphasis on on that simple measure when allocating capital. Similar to Agarwal, Green, and Ren (2018), we estimate each model using 24 months of return data for each fund. As a robustness test, we also estimate the model using 36 months of return data. Theory suggests that greater access to leverage may be associated with an increase in beta risk, and historical betas may underestimate risk. Following Thompson (1995) and MacKinlay (1997), we therefore use post-SCOOS period data to estimate the betas.[6] For example, the seven factor model is estimated using the following regression for months t to $t + 23$:

$$R_{i,m} = a + \beta_i F_{7,m} + \epsilon_{i,m}, \tag{2}$$

where $R_{i,m}$ is the net return of fund i in month m, and $F_{7,m}$ are the seven risk factors of Fung and Hsieh (2004), including three trend-following risk factors constructed from portfolios of lookback straddle options on currencies, commodities, and bonds; two equity-oriented risk factors including the S&P 500 index monthly total return and the size spread between Russell 2000 index monthly total return and the S&P monthly total return; and two bond-oriented risk factors using change in the 10-year treasury constant maturity yield and the change in the Moody's Baa yield less 10-year treasury constant maturity yield.[7] We then calculate monthly alphas as the difference between

[6]The results are essentially unchanged if the betas are estimated instead over the pre-SCOOS period.

[7]Bond, commodity, and currency trend-following factors are obtained from David A. Hsieh's data library available at `http://people.duke.edu/~dah7/DataLibrary/TF-Fac.xls`. Equity-oriented and emerging market risk factors are from Morningstar. Bond-oriented risk factors are from the Federal Reserve Bank of

realized returns and model fitted returns, and compound them into quarterly alphas. For example, the seven factor alpha ($Alpha7_{i,t}$) for quarter t is calculated as follows:

$$Alpha7_{i,t} = \prod_{m-2}^{m} (1 + R_{i,m} - \hat{R}_{i,m}) - 1, \tag{3}$$

where $\hat{R}_{i,m}$ is the monthly fitted return, calculated by multiplying the factor loadings ($\hat{\beta}_i$) by the factor realizations for each month m in quarter t. We similarly estimate the CAPM alpha ($AlphaCAPM_{i,t}$) using the return on the S&P500 total return index as the market return, and the 1-month T-bill rate as the risk-free rate. In addition, we calculate the volatility of net returns, Sharpe Ratio, and the standard error from the 7-factor model using the subsequent 24 months of return data to measure risk.

2.3 Summary Statistics

Table 1 reports the summary statistics. The sample is made up of 23,991 fund-quarter observations on qualifying hedge funds between 2012:Q4 and 2022:Q4 that report at least one SCOOS creditor on Form PF's question 47, report either quarterly returns or a complete set of monthly returns in a given quarter on Form PF, and also provide information on gross assets, net assets and borrowing in that quarter. The changes in the availability of leverage ($\Delta LevAvail$) have an average of zero and a standard deviation of 0.23. The changes can range from -1 if all creditors of a given fund report a decrease in the availability of leverage to +1 if all creditors report an increase. The average NAV is \$2.20 billion, GAV is \$6.21 billion, and GNE is \$23.90 billion for the average fund/quarter. Total borrowing ($TotBorrow$) is \$3.72 billion on average, most of which is secured. Leverage obtained through total borrowing $LevTotBorrow$, secured borrowing $LevSecBorrow$, and gross notional exposures including both derivatives and borrowing $LevGNE$ are 1.39%, 1.39%, and 7.74%, as a fraction of NAV, respectively. The ownership concentration ($OwnConcent$), measured as the ownership fraction of top 5 beneficial owners, is 60.94%. Institutional investors on average hold 82.81% of NAV ($InstitOwn$). The average fund has about 3 borrowing counterparties reported on question 47 ($CounterCount$) and 3 prime brokers reported on Form ADV ($PBCount$), and its counterparty concentration Herfindahl measure ($CounterConcent$) is 0.59. On average, it would take 49.19 days to liquidate a fund's portfolio ($PortIlliq$), and 176.67 days to redeem its capital ($ShareRestrict$).

The average net quarterly return ($NetRet$) is 1.91%, and the average gross quarterly return

St. Louis (FRED).

($GrossRet$) is 2.53%. The average fees, measured as the difference between gross and net returns, are 0.62% per quarter. The quarterly 7-factor alpha ($Alpha7$) is 1.19% and the CAPM alpha ($AlphaCAPM$) is 0.93% for the 18,378 fund-quarter observations with sufficient data to estimate the rolling betas.[8] The quarterly Sharpe Ratio is 0.72%, the standard deviation of quarterly returns ($StdDev$) is 2.97%, and idiosyncratic volatility, measured by the standard error from the 7-factor model ($StdErr$) is 2.43% on average.

3 Regressions

3.1 Leverage Availability and Hedge Fund Borrowing

How does the availability of leverage from prime brokers affect hedge funds' borrowing? We first examine whether changes in the availability of leverage, as reported by the connected prime brokers to SCOOS in quarter $t-1$, explain changes in hedge funds' borrowing and use of leverage in the post-survey quarter (t) from the pre-survey quarter ($t-2$). Specifically, we estimate the following regression:

$$\Delta Borrow_{h,t} = \beta \Delta LevAvail_{h,t-1} + \mu_t + \eta_h + \epsilon_{h,t}, \quad (4)$$

where $\Delta Borrow_{h,t}$ is the change in borrowing or leverage of hedge fund h from the pre-survey quarter ($t-2$) to the post-survey quarter (t). $\Delta LevAvail_{h,t-1}$ is the lagged change in the availability of leverage from connected prime brokers in quarter $t-1$, and μ_t denotes time fixed effects. Standard errors are clustered by fund.

Table 2 reports the estimates of β, the coefficient on $\Delta LevAvail_{h,t-1}$. As shown in columns (1) and (2), respectively, the estimated β is significant for both total ($\Delta TotBorrow$) and secured borrowing changes ($\Delta SecBorrow$), indicating that hedge funds connected with prime brokers who increase the availability of leverage to their hedge fund clients increase their borrowing relative to other hedge funds. The economic magnitude of the effect is meaningful, with an increase in the availability of leverage from the connected prime brokers (a change from 0 to 1 in the weighted measure) leading to an increase in borrowing of about 6%. Column (3) shows that changes gross notional leverage, $\Delta LevGNE$, are also positively related to changes in the availability of leverage. Overall, the estimates show that funds with greater leverage availability increase their borrowing

[8] We require at least 12 monthly return observations for each fund in a given 24-month window. The results are qualitatively unchanged if we require the full set of 24 observations, but the number of fund-quarter observations with available estimates of alpha is reduced.

and leverage. The relaxation of leverage constraints leads to increased borrowing and leverage, suggesting that these constraints are binding on average.

3.2 Leverage Availability and Hedge Fund Performance

We examine next the relationship between the availability of leverage and hedge funds returns and alphas. In the absence of leverage constraints, Modern Portfolio Theory (Sharpe, 1964; Lintner, 1965) suggests that that there should be no relationship between the use of leverage and risk-adjusted returns, as the use of leverage and optimal portfolio choice should be independent decisions. Holding the underlying portfolio constant, greater use of leverage is associated with greater expected return and proportionately greater risk, leaving the alpha unchanged. However, if leverage constraints exist, there could be a relationship between the availability of leverage, portfolio choice, and alpha. For example, in models of leverage constraints that vary across investors (Gârleanu and Pedersen, 2011; Frazzini and Pedersen, 2014), relatively unconstrained investors hold portfolios with higher alphas or Sharpe ratios and use leverage to amplify returns. Relatively more constrained investors hold riskier underlying assets with lower alphas to compensate for their lack of access to leverage. Our data allow us to directly test these theories using differences across hedge funds in the availability of leverage.

To examine the relationship between the availability of leverage to hedge funds and their performance, we estimate the following regression:

$$Performance_{h,t} = \beta \Delta LevAvail_{h,t-1} + Controls_{h,t-1} + \mu_t + \eta_h + \epsilon_{h,t}, \tag{5}$$

where $Performance_{h,t}$ is one of the following performance measures: gross return ($GrossRet$), net return ($NetRet$), Sharpe Ratio ($SharpeRatio$), CAPM alpha ($AlphaCAPM$), or 7-factor alpha ($Alpha7$) of hedge fund h in quarter t. $\Delta LevAvail_{h,t-1}$ is the lagged change in the availability of leverage from connected prime brokers, and $Controls_{h,t-1}$ are hedge fund-level control variables. μ_t denotes time fixed effects, and η_h hedge fund fixed effects. Standard errors are clustered by fund.

Table 3 reports the regression estimates using $GrossRet$ and $NetRet$ as the performance measures. The regressions are estimated both with and without fund fixed effects. The coefficient on $\Delta LevAvail_{h,t-1}$ is significant positive across specifications, indicating that changes in the availability of leverage from prime brokers predict hedge fund returns. For example, the β estimate in column (1) indicates that when the availability of leverage increases by 1 for a given hedge fund – indicating that all of its counterparties have increased the availability of leverage to their hedge fund clients – the fund's quarterly net return will subsequently increase by 0.98%. The estimated effect for gross returns in columns (3) and (4) is even larger, ranging from 1.14% to 1.21% with and without fund fixed effects, respectively.

The larger estimated effect of leverage availability on gross returns compared to net returns suggests that, besides benefiting investors, greater access to leverage also benefits fund managers through greater performance fees. Based on similar regressions as those for returns, we confirm in Table 4 that fund fees, measured by the difference between gross and net returns, are significantly larger for funds with greater access to leverage. The estimated coefficient for fees on leverage availability is 0.24 and 0.16 in columns (1) and (2), without and with fund fixed effects, respectively, each significant at the 1% level. The effect of leverage availability on fees is largely explained by the higher gross returns generated by funds with better access to leverage. As shown in columns (3) and (4), each 1% increase in gross returns results in about 0.1% in additional fees.

The estimates in Table 3 are significant and large, indicating that the relaxation of leverage constraints allows hedge funds to generate higher returns. Next, we examine if the positive relationship between the availability of leverage and hedge fund returns reflects higher risk taking by hedge funds associated with greater use of leverage, or if the relaxation of leverage constraints allows hedge funds to generate higher alphas.

Table 5 shows the estimates using different measures of risk adjusted returns as the dependent variable. The coefficients on $AlphaCAPM$, $Alpha7$, and the $SharpeRatio$ are all positive significant, indicating that the relaxation of leverage constraints allows hedge funds to generate higher risk-adjusted returns. For example, if all connected prime brokers make more leverage available to their hedge fund clients in a given quarter, their hedge fund clients generate a CAPM alpha that is 0.51% higher over the subsequent quarter, and a 7-factor alpha that is 0.33% higher. Compared to the performance estimates in Table 3 that do not adjust for risk, the the estimates in Table 5 are smaller, indicating that one-half or more of the effect of leverage availability on fund performance is explained by risk taking. However, higher availability of leverage also allows hedge funds to engage in more sophisticated, alpha-generating trades that do not increase their risk exposures, as measured by return volatility, CAPM beta, or the seven-factor model betas estimated over the post-survey period. Taken together, the results in Tables 1, 2, and 3 show that less constrained hedge funds use higher leverage to amplify their returns and generate higher alphas, as hypothesized for example by Frazzini and Pedersen (2014).

In Table 6, we analyze whether the results are robust to including variables at the hedge fund level that have been shown to be associated with hedge fund returns, including (lagged) leverage, fund size, institutional ownership, portfolio illiquidity, and share restrictions. The performance measure in these regressions is the 7-factor alpha, and the regressions are estimated without fixed effects. The alpha is significantly larger for funds with greater lagged leverage. However, the availability of leverage remains positively related with hedge funds' alpha even after controlling for past use of leverage and the other control variables. Among the control variables, funds with higher past leverage appear to generate higher alpha. Portfolio illiquidity and share restrictions are positively associated with hedge fund alpha, consistent with the findings of Sadka (2010) and Teo (2011) that funds that invest in illiquid assets and funds that impose longer restrictions on investor redemptions generate higher alphas. Other variables such as fund size, institutional ownership or its concentration are not significantly related with the 7-factor alpha.

3.3 Leverage Availability in the Cross-Section and Time-Series

Access to leverage may have varying implications for different hedge funds and at different points in time. Funds with few alternatives to borrowing from their prime brokers—such as those those with few borrowing counterparties, and those that predominantly rely on borrowing rather than derivatives for leverage—are likely more exposed to changes in the availability of leverage from their existing counterparties. We test these hypotheses by interacting the variable of interest, $\Delta LevAvail$, with (lagged) measures of the number or counterparties or prime brokerage relationships and reliance on borrowing. The results are reported in Table 7. The coefficients on the interaction with the number of counterparties ($CounterCount$) and the number of prime brokers ($PBCount$) are both statistically significant and negative, indicating that the alphas of hedge funds simultaneously borrowing from a greater number of counterparties, and those of hedge funds connected to many prime brokers, are less sensitive to changes in the availability of leverage. This finding is consistent with the hypothesis that shocks to counterparties matter less for hedge funds with sources of borrowing diversified across multiple counterparties or prime brokers. Moreover, the interaction with the share of a hedge fund's gross exposure that is sourced through borrowing ($BorrowShare$) is significant positive, showing that the availability of leverage from prime brokers affects more the performance of hedge funds that predominantly rely on borrowing for their leverage and less those that source synthetic leverage through derivatives.

In the time-series, access to leverage could affect hedge funds' ability to generate alpha more strongly when financing conditions are tight and when there are profitable trading opportunities. When financing conditions are tight, such as during periods of market stress, arbitrageurs with limited access to prime brokerage financing may be unable to take advantage of profitable trading opportunities and may even be forced to sell their positions at firesale prices (Shleifer and Vishny, 2011). In contrast, arbitrageurs with relatively unimpaired access to leverage are better placed to take advantage of the attendant trading opportunities. We use several measures to proxy for the tightness of financial conditions. First, we use the spread between 3-month LIBOR and the 3-month overnight index swap rate, a measure of dealer funding costs in excess of the expected federal funds rate ($LIBOR - OIS$). Another measure of the tightness of financing conditions is the primary dealer CDS spread, which measures the cost of protection against default of hedge fund lenders. The spread is calculated as the equal-weighted average across primary dealers with outstanding 5-year CDS contracts. We also consider the BAML bond market volatility index, since financing conditions tend to tighten during periods of elevated interest rate volatility. Finally, we use the returns on the S&P500 index. Financing conditions are tighter following stock price declines. Furthermore, Grinblatt, Jostova, Petrasek, and Philipov (2020) show that most hedge funds are contrarian traders, finding profitable trading opportunities when markets decline and other asset managers such as mutual funds are forced to sell.

In addition, we include several measures of trading opportunities as an interaction variable. As discussed by Frazzini and Pedersen (2014), trading opportunities for leveraged investors are high when the returns from investing in a leveraged portfolio of low beta stocks are high relative to returns of investing in high beta stocks. We therefore consider the returns of the global betting against beta factor ($BABret$) as a measure of hedge funds' investment opportunities. Finally, we consider the expected profitability of two popular arbitrage trades, namely the Treasury cash-futures basis ($FutBasis$), and the corporate bond-CDS basis ($CDSBasis$). Both of these arbitrage trades are popular with hedge funds and require significant leverage to be profitable (Mitchell and Pulvino, 2012; Kruttli, Monin, Petrasek, and Watugala, 2021).

In Table 8, we interact these variables with the availability of leverage. The interaction variables except for S&P500 and BAB returns are standardized for ease of interpretation and measured at the end of each quarter; the returns are not standardized and are measured on a quarterly basis. We find that the availability of leverage more strongly affects hedge funds' ability to generate alpha during periods when dealer funding spreads and dealer CDS spreads are high, and periods with elevated interest rate volatility and low returns on the S&P500 index. For example, we estimate that if primary dealer CDS spreads increase by one standard deviation, the sensitivity of funds' alphas to the availability of leverage almost doubles compared to its average level (from 0.964 to 1.837). The economic effects of one-standard deviation increases in LIBOR-OIS spread and the MOVE index are smaller but also significant. These findings support the hypothesis that the availability of leverage is especially important during periods with tighter financing conditions.

Table 8 further shows that the availability of leverage matters more for hedge fund performance when trading opportunities are abundant. When arbitrage opportunities are present in the market—as measured by high returns from betting against beta, elevated Treasury bond-futures basis, or elevated bond-CDS basis—the availability of leverage becomes a more important factor for hedge funds' ability to generate alpha. For example, a one-standard deviation increase in the bond-futures basis is associated with an increase in the sensitivity of hedge fund alphas to leverage availability by a factor of more than three (from 0.573 to 1.844). These findings strongly indicate that access to leverage affects hedge funds' alphas through the availability of trading opportunities that require financing.

3.4 Counterparty Analysis

Our results thus far have been aggregated at the fund level across counterparties. Next, we present disaggregated analysis at the fund-creditor level. Specifically, we examine whether hedge funds borrow more from creditors that increase the availability of leverage compared to other creditors. In addition to to providing a micro-foundation for the analysis at the fund level, the analysis at the fund-creditor level allows us to measure the substitution in borrowing between the creditors of a given fund. At the fund-creditor level, we estimate the following regression:

$$\Delta LogAmtOwed_{h,c,t} = \beta \Delta LevAvail_{c,t-1} + Controls_{h,t-1} + \mu_t + \eta_h + \theta_c + \epsilon_{h,c,t}, \qquad (6)$$

where $\Delta LogAmtOwed_{h,c,t}$ is the log-change in the amount owed by hedge fund h to creditor c from the pre-survey quarter $(t-2)$ to the post-survey quarter (t). To measure the log-change in borrowing, we only include borrowing counterparties connected to a hedge fund both in quarter $t-2$ and in quarter t. $\Delta LevAvail_{c,t-1}$ is the change in the availability of leverage from counterparty c during the survey quarter $(t-1)$. In some specifications, we interact $\Delta LevAvail_{c,t-1}$ with fund-level variables to examine how the available leverage is allocated among different hedge fund clients. μ_t denotes time fixed effects, η_h fund fixed effects, and θ_c counterparty fixed effects. Alternatively, the regression is estimated with fund/time or fund/counterparty fixed effects. The sample includes only funds that borrow from at least 2 counterparties. Standard errors are clustered by counterparty and time.

Table 9 reports the estimates of β, the coefficient on $\Delta LevAvail_{h,t-1}$. The estimated β is significant positive across specifications, indicating that funds increase their borrowing from counterparties that make more leverage available to their hedge fund clients. For example, the β estimate in column (1) suggests that if a lender reports an increase in the availability of leverage to its hedge fund clients, its clients will on average borrow 5.0% more from that lender. Columns (2-6) show that the relationship between leverage availability from a given counterparty and the change in the amount borrowed from that counterparty holds even with additional controls and after including fund/time and fund/counterparty fixed effects. The estimate of β after controlling for fund/time fixed effects is 3.1% in column (3), indicating that funds substitute borrowing away from counterparties that decrease leverage availability to their hedge fund clients to counterparties that increase the availability of leverage. The substitution effect is large, accounting for almost four-fifths of the of the reduction in borrowing among hedge funds with several counterparties. This result is consistent with our previous finding that the effect of leverage availability is greatest among funds with a small number of borrowing counterparties, as these funds find it difficult to substitute their borrowing away from constrained creditors. Overall, the results at the fund-creditor level confirm that leverage availability has a significant effect on hedge fund borrowing from a given creditor, even controlling for the total amount borrowed by a hedge fund in a given quarter.

Since leverage availability is reported by each prime broker for all of their hedge fund clients, it is possible that available leverage is not allocated uniformly among clients. In particular, prime brokers may allocate available leverage disproportionately to clients with better investment opportunities, both because these clients demand greater leverage and because they have lower counterparty risk. One observable proxy of a fund's investment opportunities is the fund's past return or alpha. We examine in Table 10 whether leverage access depends on a fund's past performance. The results support the notion that lenders make more credit available to better performing funds. Specifically, the coefficients on the interaction between leverage availability and past return or alpha over the past 1-3 year horizon are significant positive, indicating that creditors that increase the availability of leverage to their hedge fund clients make disproportionately more credit available to better performing funds. The even-numbered columns show that these results hold even after controlling for the total amount of borrowing by each fund through fund/time fixed effects, further confirming that past performance affects the supply of credit to hedge funds. This result is consistent with previous findings of performance persistence among outperforming hedge funds (Fung, Hsieh, Naik, and Ramadorai, 2008; Jagannathan, Malakhov, and Novikov, 2010).

3.5 Robustness

We examine next the robustness of the results to an alternative measure of leverage availability. Instead of weighting the survey responses across all connected counterparties according to the amount of borrowing from each counterparty reported in Form PF's q. 47, the alternative measure is constructed as an equal-weighted average of the changes in borrowing only from a fund's prime brokers as reported on Form ADV:

$$\Delta LevAvailPB_{h,t} = \sum_{p=1}^{P} \frac{1}{P} Q9_{p,t}. \tag{7}$$

The variable $\Delta LevAvailPB_{h,t}$ measures change in the availability of leverage to hedge fund h at time t from the connected prime brokers $p = 1...P$, as identified at time $t-1$ on Form ADV, q. 24.

One advantage of constructing the leverage availability measure based on prime brokerage relationships rather than borrowing amounts is that the sample is not limited to the subset of funds that report report their counterparty borrowing amounts on Form PF's q. 47. This question identifies only creditors to which the reporting fund owed an amount equal or greater than 5% of its NAV as of the reporting date. Instead, the $LevAvailPB$ measure is constructed using all prime brokerage affiliations, as reported on Form ADV. Another advantage is that by using equal weights to construct the measure, we are implicitly allowing for the possibility that the fund may be able to use its prime brokerage connections to substitute financing from more constrained to less constrained prime brokers, regardless of the strength of affiliation with that prime broker.

Table 11 shows the regressions of hedge fund performance measures on leverage availability as measured by $LevAvailPB$. As before, the sample is made up of funds that file Form PF quarterly and provide sufficient data to calculate quarterly alphas. In addition, we require that the funds list at least one prime broker on Form ADV that is a SCOOS participant. The results reported in Table 11 are consistent with those reported in Table 5 based on the weighted measure. Regardless of the measure of performance or alpha, the availability of leverage from prime brokers in quarter q predicts hedge fund alpha in quarter $q+1$. The estimated coefficients are positive and significant, indicating that hedge funds connected to prime brokers that make more leverage available to their hedge fund clients subsequently generate superior risk-adjusted returns.

We also find that the results are robust to alternative ways of measuring hedge fund abnormal performance. For example, Table 12 shows regressions of abnormal returns on the availability of leverage, based on a 36-month estimation period for the model parameters or risk metrics. The coefficient estimates are similar to those reported in Table 5 or slightly larger, indicating a strong positive relationship between a hedge fund's access to leverage and its ability to generate alpha.

The Appendix provides additional robustness checks. Table A1 provides a robustness test for Table 2 in the body of the paper, with changes in the use of leverage measured over a one-quarter period — from the SCOOS quarter (q-1) to quarter (q) — instead of a two-quarter period from the pre-SCOOS quarter (q-2) to quarter (q). The results show that the use of leverage in quarter q responds to changes in the availability of leverage reported in quarter q-1. The estimated effect on use of leverage in Table A1 is about half of that in Table 2, suggesting that some of the changes in the use of leverage occur already during the survey quarter (q-1).

Table A2 shows the estimates from regressions of 7-factor alpha on availability of leverage, interacted with measures of changes in macroeconomic variables and trading opportunities. The regressions are similar to those in Table 8, except changes in the availability of leverage are interacted with changes in macroeconomic variables in quarter q rather than the levels of those variables. The results show that hedge fund alphas are more sensitive to changes the availability of leverage during periods of increases in primary dealer CDS, equity volatility, and several measures of arbitrage spreads.

This is consistent with the findings in the main paper that alphas are more sensitive to changes the availability of leverage when dealer CDS spreads, market volatility, and arbitrage spreads are elevated.

4 Conclusion

We find that the supply of credit from prime brokers and other borrowing counterparties affects hedge funds' use of leverage and their ability to generate alpha. These results are consistent with models of leverage constraints such as Gârleanu and Pedersen (2011); Frazzini and Pedersen (2014), in which relatively unconstrained investors hold portfolios with higher alphas or Sharpe ratios and use leverage to amplify returns. Our findings also show that the supply of leverage matters more for hedge funds with few alternatives to borrowing from their prime brokers, such as those with small prime brokerage networks. The supply of leverage is especially important for hedge fund ability to generate alpha during periods of financial market stress and when trading opportunities are abundant for those with access to financing. Overall, our findings based on survey results contribute to the literature by allowing us to distinguish, for the first time, between leverage availability and its use. The findings also shed light on previously observed patterns in the time-series and cross-section of hedge fund leverage (Ang, Gorovyy, and van Inwegen, 2011), the co-movement in hedge fund returns (Boyson, Stahel, and Stulz, 2010; Chung and Kang, 2016), and the findings of performance persistence among some hedge funds (Fung, Hsieh, Naik, and Ramadorai, 2008; Jagannathan, Malakhov, and Novikov, 2010).

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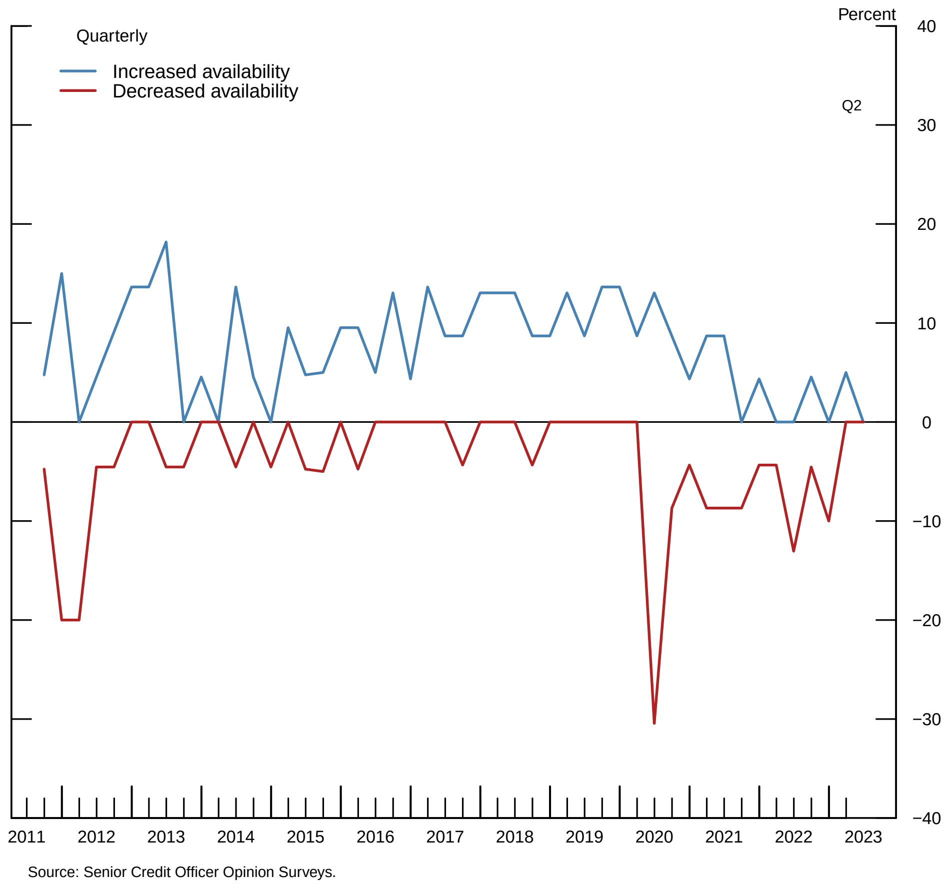

Figure 1: Percentage of dealers reporting increased or decreased availability of leverage to hedge funds. Source: SCOOS

Table 1: Summary statistics

	Mean	SD	p5	p50	p95	N
ΔLevAvail	0.00	0.23	-0.30	0.00	0.31	23,991
NAV (MM)	2,195.39	3,623.76	139.56	1,132.37	7,630.15	23,991
GAV (MM)	6,206.82	18,542.65	236.70	2,028.64	23,060.31	23,991
GNE (MM)	23,898.10	100,759.78	317.86	3,632.84	91,219.02	23,991
TotBorrow (MM)	3,717.11	15,904.99	39.36	676.16	12,816.66	23,991
SecBorrow (MM)	3,715.10	15,902.06	38.92	672.87	12,816.66	23,991
LevTotBorrow	1.39	2.93	0.09	0.61	4.72	23,991
LevSecBorrow	1.39	2.87	0.09	0.61	4.70	23,991
LevGNE	7.74	16.14	1.15	2.88	32.75	23,991
OwnConcent	60.94	27.38	22.00	57.00	100.00	23,991
InstitOwn	82.81	21.80	34.00	91.00	100.00	23,991
CounterCount	2.98	2.50	1.00	2.00	8.00	23,991
CounterConcent	0.59	0.31	0.18	0.51	1.00	23,991
PBCount	3.00	2.53	0.00	3.00	8.00	23,991
PortIlliq	49.19	87.95	0.65	13.06	310.71	23,991
ShareRestrict	176.67	116.87	19.00	170.25	366.00	23,991
NetRet	1.91	7.63	-9.36	1.83	12.76	23,991
GrossRet	2.53	8.17	-9.24	2.23	14.97	23,991
Fees	0.62	2.13	-0.42	0.38	2.78	23,991
Alpha7	1.19	5.83	-6.18	1.06	7.97	18,378
AlphaCAPM	0.93	6.60	-7.73	0.82	8.95	18,378
SharpeRatio	0.72	2.06	-1.46	0.52	3.01	18,378
StdDev	2.97	2.17	0.68	2.39	7.24	18,378
StdErr	2.43	1.66	0.67	1.99	5.72	18,378

Note: $\Delta LevAvail$ is the change in the availability of hedge fund reported in prime broker surveys and aggregated across a fund's counterparties (see Eq. 1). NAV, GAV, and GNE are the net asset value, gross asset value, and gross notional exposure, respectively. *TotBorrow* is total borrowing and *SecBorrow* is secured borrowing. *LevTotBorrow* is leverage obtained through borrowing, calculated as the ratio of *TotBorrow* and NAV. *LevSecBorrow* is calculated as the ratio of *SecBorrow* and NAV. *LevGNE* is calculated as the ratio of GNE and NAV. *OwnConcent* is the ownership share of the top 5 investors. *InstitOwn* is the share of a fund's shares held by institutional investors. *CounterCount* is the number of trading counterparties. *PBCount* is the number of prime brokers. *PortIlliq* is portfolio illiquidity, measured in days it would take to convert a portfolio into cash. *ShareRestr* are share restrictions, measured in days in which investors are allowed to withdraw their capital. *NetRet* and *GrossRet* are quarterly returns net and gross of fees, respectively. *Alpha*7 and *AlphaCAPM* are quarterly measures of alpha based on the seven-factor model or CAPM, respectively. *SharpeRatio* is the quarterly Sharpe Ratio, *StdDev* the standard deviation of quarterly returns, and *StdErr* the standard error based on CAPM. The sample period is from 2012:Q4 to 2022:Q4.

Table 2: Regressions of use of leverage on the availability of leverage

	(1) ΔTotBorrow	(2) ΔSecBorrow	(3) ΔLevGNE
ΔLevAvail	0.060**	0.062**	0.034**
	(0.024)	(0.024)	(0.014)
Observations	22535	22535	22535
Adj. Rsq.	0.016	0.016	0.027
Time FE	Yes	Yes	Yes
Fund FE	No	No	No

Note: The table shows regressions of changes in hedge fund leverage in quarter q from q-2 on changes in the availability of leverage as reported by the connected prime brokers in quarter q-1. In column (1),(2), and (3), the change in the use of leverage is measured by either the the change in total hedge fund borrowing, secured borrowing, or gross exposure, each scaled by lagged assets, respectively. Sources: Form PF and SCOOS. Standard errors (in parentheses) are clustered by fund. *** p<0.01, ** p<0.05, * p<0.10.

Table 3: Regressions of fund returns on availability of leverage

	(1) NetRet	(2) NetRet	(3) GrossRet	(4) GrossRet
ΔLevAvail	0.977***	0.979***	1.214***	1.144***
	(0.203)	(0.190)	(0.230)	(0.207)
Observations	23991	23991	23991	23991
Adj. Rsq.	0.185	0.374	0.176	0.385
Time FE	Yes	Yes	Yes	Yes
Fund FE	No	Yes	No	Yes

Note: The table shows the regression of gross and net quarterly hedge fund returns in quarter q on changes in the availability of leverage from the connected prime brokers as reported in quarter q-1. Sources: Form PF and SCOOS. Standard errors (in parentheses) are clustered by fund. *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

Table 4: Regressions of fund fees on the availability of leverage and gross returns

	(1) Fees	(2) Fees	(3) Fees	(4) Fees
ΔLevAvail	0.237***	0.164***	0.104*	0.060
	(0.067)	(0.053)	(0.063)	(0.048)
GrossRet			0.109***	0.091***
			(0.011)	(0.005)
Observations	23991	23991	23991	23991
Adj. Rsq.	0.010	0.382	0.154	0.456
Time FE	Yes	Yes	Yes	Yes
Fund FE	No	Yes	No	Yes

Note: Table shows the regression of fund fees, measured by the difference between quarterly gross and net returns, on leverage availability and contemporaneous gross returns. Sources: Form PF and SCOOS. Standard errors (in parentheses) are clustered by fund. *** p<0.01, ** p<0.05, * p<0.10.

Table 5: Regressions of abnormal returns on availability of leverage

	(1) AlphaCAPM	(2) Alpha7	(3) SharpeRatio
ΔLevAvail	0.511***	0.326**	0.139***
	(0.183)	(0.161)	(0.045)
Observations	18289	18289	18289
Adj. Rsq.	0.402	0.464	0.666
Time FE	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes

Note: Columns (1), (2), and (3) show the regression of CAPM alphas, 7-factor model alphas, and Sharpe ratios, respectively in quarter q on leverage availability in quarter q-1. The model parameters are estimated using a rolling window of 24 months. Sources: Form PF and SCOOS. Standard errors (in parentheses) are clustered by fund. *** p<0.01, ** p<0.05, * p<0.10.

Table 6: Regressions of 7-factor alphas on availability of leverage and control variables

	(1) Alpha7	(2) Alpha7	(3) Alpha7
ΔLevAvail	0.625***	0.625***	0.687***
	(0.170)	(0.169)	(0.163)
LevGNE	0.006*	0.006*	0.014***
	(0.003)	(0.003)	(0.003)
LogNAV	-0.165**	-0.176*	-0.126
	(0.071)	(0.091)	(0.091)
OwnConcent		-0.001	0.002
		(0.004)	(0.004)
InstitOwn		0.004	0.002
		(0.005)	(0.005)
PortIlliq			0.005***
			(0.002)
ShareRestrict			0.005***
			(0.001)
Observations	18378	18378	18378
Adj. Rsq.	0.002	0.002	0.022
Time FE	No	No	No
Fund FE	No	No	No

Note: Table shows the regression of 7-factor model alphas on leverage availability and control variables. Sources: Form PF and SCOOS. Standard errors (in parentheses) are clustered by fund. *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

Table 7: Regressions of 7-factor alphas on availability of leverage and interaction variables

	(1) Alpha7	(2) Alpha7	(3) Alpha7
ΔLevAvail	0.708***	1.120***	-0.143
	(0.203)	(0.224)	(0.240)
CounterCount	0.030		
	(0.028)		
ΔLevAvail x CounterCount	-0.199***		
	(0.067)		
PBCount		-0.018	
		(0.045)	
ΔLevAvail x PBCount		-0.304***	
		(0.067)	
BorrowShare			-1.184
			(0.746)
ΔLevAvail x BorrowShare			2.213**
			(0.961)
Observations	18289	18289	18289
Adj. Rsq.	0.464	0.464	0.464
Time FE	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes

Note: Table shows the regression of 7-factor model alphas in quarter q on leverage availability in quarter q-1, interacted with the number of hedge fund counterparties, number of prime brokers, and the fund's reliance on borrowing. Sources: Form PF and SCOOS. Standard errors (in parentheses) are clustered by fund. *** p<0.01, ** p<0.05, * p<0.10.

Table 8: Regressions of 7-factor alphas on availability of leverage, macroeconomic variables and trading opportunities

	(1) Alpha7	(2) Alpha7	(3) Alpha7	(4) Alpha7	(5) Alpha7	(6) Alpha7	(7) Alpha7
ΔLevAvail	0.970***	0.964***	1.025***	1.271***	0.500**	0.573***	1.017***
	(0.139)	(0.139)	(0.135)	(0.145)	(0.208)	(0.170)	(0.143)
ΔLevAvail x LIBOR-OIS	0.244*						
	(0.134)						
ΔLevAvail x DealerCDS		0.873***					
		(0.191)					
ΔLevAvail x MOVE			0.398**				
			(0.173)				
ΔLevAvail x S&P500ret				-0.088***			
				(0.020)			
ΔLevAvail x BABret					0.158**		
					(0.063)		
ΔLevAvail x FutBasis						1.271***	
						(0.292)	
ΔLevAvail x CDSBasis							0.626***
							(0.177)
Observations	18289	18289	18289	18289	18289	18289	18289
Adj. Rsq.	0.427	0.428	0.428	0.428	0.428	0.428	0.428
Time FE	No	No	No	No	No	No	No
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Table shows the regression of 7-factor model alphas in quarter q on leverage availability in quarter q-1, interacted with macroeconomic variables and and measures of trading opportunities in quarter q. LIBOR-OIS is the spread between 3-month LIBOR and the 3-month overnight index swap rate. DealerCDS is the equal-weighted CDS spread of primary dealers. MOVE is the BAML bond market option volatility index. S&P500ret is the quarterly return of the S&P500 total return index. BABret is the quarterly return of the betting against beta global factor from Frazzini and Pedersen (2014). FutBasis is the 5-year Treasury cash-futures basis, measured as the internal rate of return on buying the cheapest-to-deliver Treasury bond and selling Treasury futures. CDSBasis is the spread between the yield on North America investment grade bonds and the corresponding credit default swaps. The interaction variables except for returns are standardized and measured at quarter-end. Sources: Form PF and SCOOS. Standard errors (in parentheses) are clustered by fund. *** p<0.01, ** p<0.05, * p<0.10.

Table 9: Fund-creditor level regressions of borrowing amount on availability of leverage

	ΔLogBrrw	ΔLogBrrw	ΔLogBrrw	ΔLogBrrw	ΔLogBrrw	ΔLogBrrw
	(1)	(2)	(3)	(4)	(5)	(6)
ΔLevAvail	5.108***	4.529***	3.151**	3.138**	3.296**	2.244*
	(1.202)	(1.178)	(1.474)	(1.369)	(1.505)	(1.309)
Observations	53,155	53,155	53,155	53,155	53,155	53,155
Adjusted R^2	0.064	0.205	0.294	0.387	0.305	0.513
Controls	No	Yes	No	Yes	No	Yes
Fund FE	Yes	Yes	No	No	No	No
Time FE	Yes	Yes	No	No	No	No
Counterparty FE	Yes	Yes	Yes	Yes	No	No
Fund×Time FE	No	No	Yes	Yes	Yes	Yes
Fund×Counterparty FE	No	No	No	No	Yes	Yes

Note: Table shows regressions of log-changes in fund-creditor borrowing amounts in quarter q from quarter q-2 on leverage availability from each creditor, reported in quarter q-1. The sample is made up of borrowing counterparties listed in Form PF question 47 in each quarter. The regressions only include funds that borrow from two or more counterparties in a given quarter. Sources: Form PF and SCOOS. Standard errors (in parentheses) are clustered by Counterparty×Time. *** p<0.01, ** p<0.05, * p<0.10.

Table 10: Fund-creditor level regressions of borrowing amount on availability of leverage and fund performance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ΔLevAvail	5.629***	3.580**	5.794***	4.765***	6.108***	5.539***	5.782***	3.870**	7.832***	6.241***	8.001***	6.624***
	(1.386)	(1.601)	(1.528)	(1.735)	(1.892)	(1.918)	(1.444)	(1.847)	(1.856)	(2.142)	(1.959)	(2.102)
NetRet1Y	2.927***											
	(0.532)											
NetRet2Y			0.738									
			(0.631)									
NetRet3Y					0.505							
					(0.803)							
AlphaCAPM1Y							3.789***					
							(0.564)					
AlphaCAPM2Y									2.716***			
									(0.689)			
AlphaCAPM3Y											1.715*	
											(0.917)	
ΔLevAvail	3.926***	3.062**										
×NetRet1Y	(1.268)	(1.375)										
ΔLevAvail			3.937***	2.667**								
×NetRet2Y			(1.159)	(1.100)								
ΔLevAvail					2.976*	2.727**						
×NetRet3Y					(1.642)	(1.257)						
ΔLevAvail							4.099***	4.238***				
×AlphaCAPM1Y							(1.340)	(1.418)				
ΔLevAvail									4.140**	3.451**		
×AlphaCAPM2Y									(1.736)	(1.508)		
ΔLevAvail											3.832**	2.984**
×AlphaCAPM3Y											(1.653)	(1.315)
Observations	44,180	44,180	34,994	34,994	29,359	29,359	38,129	38,129	29,180	29,180	27,358	27,358
Adjusted R^2	0.068	0.271	0.074	0.279	0.080	0.282	0.070	0.259	0.070	0.270	0.074	0.273
Controls×ΔLevAvail	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Fund FE	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Time FE	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Counterparty FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund×Time FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: Table shows regressions of log-changes in fund-creditor borrowing amounts in quarter q from quarter q-2 on leverage availability from each creditor, reported in quarter q-1, and measures of past returns and alphas. The sample is made up of borrowing counterparties listed in Form PF question 47 in each quarter. The returns and alphas variables are standardized. The regressions only include funds that borrow from two or more counterparties in a given quarter. Sources: Form PF and SCOOS. Standard errors (in parentheses) are clustered by Counterparty×Time. *** p<0.01, ** p<0.05, * p<0.10.

Table 11: Regressions of abnormal returns on an alternative measure of availability of leverage

	(1) AlphaCAPM	(2) Alpha7	(3) SharpeRatio
ΔLevAvailPB	0.612***	0.360**	0.135***
	(0.186)	(0.167)	(0.050)
Observations	23244	23244	23244
Adj. Rsq.	0.349	0.401	0.572
Time FE	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes

Note: Table shows the regression of measures of abnormal returns in quarter q on leverage availability in quarter q-1. Leverage availability is measured as the equal-weighted average change in the availability of leverage reported by the connected prime brokers. Sources: Form PF and SCOOS. Standard errors (in parentheses) are clustered by fund. *** p<0.01, ** p<0.05, * p<0.10.

Table 12: Regressions of abnormal returns on availability of leverage - 36 mth estimation period

	(1) AlphaCAPM	(2) Alpha7	(3) SharpeRatio
ΔLevAvail	0.553***	0.413**	0.140***
	(0.186)	(0.172)	(0.043)
Observations	18438	18438	18438
Adj. Rsq.	0.414	0.462	0.679
Time FE	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes

Note: Columns (1), (2), and (3) show the regressions of 36-month CAPM alphas, 7-factor model alphas, and Sharpe ratios, respectively, in quarter q on leverage availability in quarter q-1. The model parameters are estimated using a rolling window of 36 months. Sources: Form PF and SCOOS. Standard errors (in parentheses) are clustered by fund. *** p<0.01, ** p<0.05, * p<0.10.

A Appendix

Table A1: Regressions of use of leverage on the availability of leverage – one quarter change

	(1) ΔTotBorrow	(2) ΔSecBorrow	(3) ΔLevGNE
ΔLevAvail	0.034**	0.035**	0.023**
	(0.015)	(0.015)	(0.009)
Observations	23991	23991	23991
Adj. Rsq.	0.011	0.012	0.019
Time FE	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes

Note: The table shows regressions of changes in hedge fund leverage in quarter q from q-1 on changes in the availability of leverage as reported by the connected prime brokers in quarter q-1. In column (1),(2), and (3), the change in the use of leverage is measured by either the the change in total hedge fund borrowing, secured borrowing, or gross exposure, each scaled by lagged assets, respectively. Sources: Form PF and SCOOS. Standard errors (in parentheses) are clustered by fund. *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

Table A2: Regressions of 7-factor alphas on availability of leverage, changes in macroeconomic variables and trading opportunities

	(1) Alpha7	(2) Alpha7	(3) Alpha7	(4) Alpha7	(5) Alpha7	(6) Alpha7	(7) Alpha7
ΔLevAvail	1.271***	0.500**	1.032***	0.860***	0.861***	0.946***	1.133***
	(0.145)	(0.208)	(0.142)	(0.150)	(0.142)	(0.141)	(0.144)
ΔLevAvail x S&P500ret	-0.088***						
	(0.020)						
ΔLevAvail x BABret		0.158**					
		(0.063)					
ΔLevAvail x ΔDealerCDS			0.921***				
			(0.162)				
ΔLevAvail x ΔVIX				0.523***			
				(0.171)			
ΔLevAvail x ΔFutBasis					0.985***		
					(0.159)		
ΔLevAvail x ΔCDSBasis						0.619***	
						(0.149)	
ΔLevAvail x ΔSwapSpread							0.405**
							(0.176)
Observations	18289	18289	18289	18289	18289	18289	18289
Adj. Rsq.	0.428	0.428	0.428	0.428	0.428	0.428	0.428
Time FE	No	No	No	No	No	No	No
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Table shows the regression of 7-factor model alphas in quarter q on leverage availability in quarter q-1, interacted with changes in macroeconomic variables and measures of trading opportunities in quarter q. S&P500ret is the quarterly return of the S&P500 total return index. BABret is the quarterly return of the betting against beta global factor from Frazzini and Pedersen (2014). DealerCDS is the equal-weighted CDS spread of primary dealers. VIX is the CBOE equity volatility index. FutBasis is the 5-year Treasury cash-futures basis, measured as the internal rate of return on buying the cheapest-to-deliver Treasury bond and selling Treasury futures. CDSBasis is the spread between the yield on North America investment grade bonds and the corresponding credit default swaps. SwapSpread is the spread between the par yield on a 5-year Treasury bond and swap rate of the same maturity. All interaction variables except for returns are standardized and measured at quarter-end. Sources: Form PF and SCOOS. Standard errors (in parentheses) are clustered by fund. *** $p<0.01$, ** $p<0.05$, * $p<0.10$.