The Volcker Rule and the hedge fund liquidity circle*

Michael Bowe, Olga Kolokolova, Lijie Yu†

First version: September 24, 2019
This version: January 14, 2020

Abstract

This paper finds that the implementation of the Volcker Rule (section 619 of the 2010 Dodd-Frank Act) profoundly impacts overall equity market liquidity, the funding liquidity of hedge funds, and their liquidity provision to the market. Analysis of a sample of 8,686 hedge funds reveals that following the passage of the Volcker Rule legislation, funding flows to hedge funds decline, and their flow-performance sensitivity increases. Hedge funds also reduce their exposure to market liquidity and realign their market-making activities to the most liquid segment of stocks. The impact appears more pronounced for those funds with business connections to systemically important US banks, weak past performance, and adopting non-directional investment strategies.

Keywords: Volcker Rule; Hedge funds; Liquidity risk; Market liquidity.

*We thank Michael Brennan, Tarun Chordia, Ian Garrett, Mariassunta Giannetti, Janne Aijo, Denis Davydov, Jussi Nikkinen, Anita Pennathur, Stefan Petry, Valeri Sokolovski, Alex Taylor, and Abhishek Ganguly, and comments received from seminar participants at the University of Liverpool, University of Manchester, and the University of Vaasa. Any errors or omissions remain the responsibility of the authors. The authors also gratefully acknowledge the financial support of the University of Manchester, the Centre for the Analysis of Investment Risk (CAIR), and the China Scholarship Council (CSC).

†Michael Bowe (michael.bowe@manchester.ac.uk) is affiliated with Alliance Manchester Business School, the University of Manchester and the Department of Accounting and Finance, the University of Vaasa. Olga Kolokolova (olga.kolokolova@manchester.ac.uk) is affiliated with Alliance Manchester Business School, the University of Manchester. Lijie Yu (lijie.yu@manchester.ac.uk) is affiliated with Alliance Manchester Business School, the University of Manchester.

1 Introduction

In response to the financial crisis of 2008, the US government implements one of the most prominent and far-reaching financial regulations of recent times, the 2010 Dodd-Frank Wall Street Reform and Consumer Protection Act. Section 619 of the Act, the Volcker Rule represents one of its core regulatory directives. This Rule aims to reduce banks' overall risk and restricts both proprietary trading and investment by banking entities in hedge funds and private equity funds, also known as covered funds. The Act became law in July 2010, giving banks a five-year timeframe to achieve full regulatory compliance. Recent literature examines the Volcker Rule's impact on the banking sector. Keppo and Korte (2016) show that following the Volcker Rule, banks reduce the size of their trading books while their overall risk-taking does not decrease. Chung et al. (2016) calibrate a stochastic control model to US banks, and find that the Volcker Rule raises the default probability of regulated banks. Schäfer et al. (2015) and Elayan et al. (2018) provide evidence that the effects of the Volcker Rule are heterogeneous across the banking sector. Specifically, US investment banks and systemically important banks experience a decrease in equity prices and an increase in credit default swap (CDS) spreads relative to both non-investment and non-systemic banks. The Volcker Rule also affects other market participants. For example, Bao et al. (2018) find that the liquidity of stressed bonds deteriorates after the Volcker Rule as banks retrench from market-making activity.

In this paper we examine whether banking sector regulations also affect the hedge fund industry. Hedge funds play an increasingly important role in gloabl financial markets. According to BarclayHedge,[1] global hedge fund assets under management have grown 75-fold within 30 years, increasing from $40 billion in 1990 to nearly $3 trillion in 2017. Indeed, trading of hedge funds now accounts for at least one-third of the total daily trading volume on the New York Stock Exchange (NYSE) alone (Cao et al., 2017). Mügge (2014) maintains that hedge funds are crucial providers of liquidity and drivers of price formation in global financial markets. However, given their relatively high use of leverage, hedge funds are particular vulnerable to market and funding liquidity risk. They may also pose risks to financial stability due to their close relationship with large and complex financial institutions (LCFIs), especially commercial and investment banks, as became evident following the collapse of Long-Term Capital Management L.P. (Dardanelli, 2011; King and Maier, 2009).[2] This network of connectivity results in increasing calls for controlling hedge fund activities. Indirectly regulating hedge funds through constraining their counterparties is often considered to be the most effective mechanism (King and Maier, 2009; Dardanelli, 2011; Nabilou and Pacces, 2015).

Despite the sector's importance, to the best of our knowledge no studies to date assesses the impact of the Volcker Rule on the hedge fund industry. Figure 1 illustrates the 'liquidity

[1]The data is available at https://www.barclayhedge.com/solutions/assets-under-management/hedge-fund-assets-under-management/hedge-fund-industry/.

[2]We adopt the term 'large and complex financial institutions' (LCFIs), which refers to the largest global commercial and investment banks, as in King and Maier (2009).

circle' of hedge funds, which is likely to be affected by the regulations. First, the ban on proprietary trading by banks and the reduction in their market-making activity may create liquidity shortages in certain financial instruments, adversely affecting overall market liquidity. Second, hedge funds that customarily attract investments from banks may experience negative liquidity shocks, due to the prohibition of bank investment into hedge funds. In fact, in the period encompassing Volcker Rule implementation, the hedge fund industry experiences deteriorating performance, and in 2016 suffers a significant net funding outflow of $102 billion. Large investment banks retreat from hedge fund investments after the implementation of the regulations. Morgan Stanley, for example, was looking to sell its 19% stake in the $17.5 billion London-based Lansdowne Partners LLP in 2015,[3] Goldman Sachs continuously sold off its hedge fund holdings,[4] and it cut its total exposure on non-Volcker-compliant investments by 60% over the five years until 2016.[5] Large investor redemptions are important determinants of hedge funds exposure to funding risk (Klaus and Rzepkowski, 2009). Both of these channels, market liquidity and funding liquidity, impact the trading decisions of hedge funds and their liquidity provision to the market, thus closing the liquidity circle. In addition, hedge funds obtain financing and leverage from prime brokers, which also contributes to their funding liquidity. Historically, hedge funds have been assuming significant liquidity risk, as reflected in their documented positive returns to liquidity provision (Sadka, 2010). However, this is likely to change as the Volcker Rule affects the whole liquidity circle.

[Figure 1 in here]

In this paper we analyse how implementation of the Volcker Rule impacts the evolution of the entire spectrum of the liquidity-related channels of the 'liquidity circle'. We find that following implementation of the Rule, the average bid-ask spread increases and becomes more volatile, and the returns from liquidity provision turn negative, all indicting an overall reduction in market liquidity. Average flows to hedge funds reduce and their flow-performance sensitivity increases, indicating an environment of tighter funding liquidity for hedge funds. These two factors lead to a reduction in hedge funds' exposure to market liquidity, inducing a drift towards more liquid investments. This effect is stronger for funds having business connections with the large US banks targeted by the Rule, as well as those with non-directional investment styles, in particular Equity Market Neutral and Relative Value funds. As Equity Market Neutral and Relative Value funds exploit price differentials between related financial instruments, thereby reducing mispricing, one implication of this finding is that overall market efficiency may be negatively affected as hedge funds respond to the changing environment after the Volcker Rule.

[3]Juliet Chung and Emily Glazer. Morgan Stanley Aims to Sell Stake in Lansdowne Partners. The Wall Street Journal, February 8, 2015.

[4]Nathaniel Popper. Goldman Sachs Sells $285 Million in Hedge Fund Holdings. The New York Times, November 5, 2014.

[5]Ryan Tracy. Big Banks Could Get More Time to Sell Funds Banned by Volcker Rule. The Wall Street Journal, December 12, 2016.

Our analysis extends a growing literature on the interconnectedness between hedge funds and other major financial institutions (Chan et al., 2005). Billio et al. (2012) find that the returns of banks, insurance companies, broker-dealers, and hedge funds exhibit increasing correlation during the 2000s, with the returns of banks and insurance companies influencing hedge fund returns. Franzoni and Giannetti (2019) show that hedge funds affiliated with financial conglomerate can access more stable funding, leading them to provide liquidity during periods of financial turmoil. Using fund-of-funds data, Ang et al. (2011) report that hedge fund leverage is counter-cyclical in comparison to the leverage of listed financial intermediaries. They find that both reductions in funding costs and enhanced bank returns predict an increase in hedge fund leverage.

Prior research also focuses on the relationship between hedge funds and their prime brokers. Chung and Kang (2016) provide evidence that hedge funds sharing prime brokerage services exhibit a strong co-movement in returns, which the authors attribute to information flows initiated by the common broker. Kumar et al. (2018) document evidence that information regarding corporate client loans disseminates from prime brokers to hedge funds. Prime brokerage relations also expose hedge funds to significant counterparty risk. Boyson et al. (2010) find that the probability of hedge fund contagion increases significantly following adverse shocks to their prime broker's stock price. Aragon and Strahan (2012) show that hedge funds using Lehman Brothers as their prime broker experience a decline in funding liquidity subsequent to Lehman's bankruptcy in 2008. Furthermore, stocks traded by the Lehman-connected funds experience a greater decrease in liquidity than other stocks following its bankruptcy, supporting the interaction between funding liquidity and market liquidity (Brunnermeier and Pedersen, 2008). Kruttli et al. (2018) analyse the credit exposures between Deutsche Bank in its role as a prime broker and its affiliated hedge funds, finding that liquidity shocks are transmitted to these connected funds, resulting in a reduction in their aggregate borrowing.

This study contributes to the literature by examining whether the documented relationship between large financial institutions and affiliated hedge funds extends beyond the widely studied prime brokerage connection. A recent study by Dahlquist et al. (2019) show that the documented empirical relation between the returns of hedge funds and their prime brokers is entirely driven by systematic risk exposure. Once they control for this risk factor, the remaining return linkages are no longer significant, except in cases such as Lehman's bankruptcy, where the prime broker experiences extremely large adverse shocks (akin to bankruptcy). We build on this insight, analysing the nexus of relationships between LCFIs and hedge funds to test whether any post Volcker Rule changes in hedge fund flows, liquidity exposure and liquidity provision are attributable to the prime brokerage relationship, or arise from other business links, relating to investment, audit, custodianship or the advisory roles of banks. The empirical results corroborate the insights of Dahlquist et al. (2019) to the extent that a documented prime brokerage relationship with a large bank does not significantly influence any measured impacts of the Volcker Rule. Indeed, it appears it is the presence of other contractual links between

hedge funds and LCFIs which primarily determine the Volcker Rule's effect.

This paper also relates to the literature on the the role of hedge funds in the financial markets. Cao et al. (2017) show that stocks purchased by hedge funds experience an improvement in their pricing efficiency during non-crisis periods, while Ben-David et al. (2013) and Jiao (2012) document hedge fund holdings contain predictive power for future stock returns. Kolokolova et al. (2017) focus on the impact of hedge fund flows in the bond market and find that an increase in fund flows predicts a future decline in corporate bond yields. This effect is amplified when market liquidity is low. Other studies document that market liquidity risk plays an important role in determining hedge fund performance. Sadka (2010) documents that market liquidity risk is an important determinant of hedge fund returns, with hedge funds that load up on liquidity risk outperforming low-loading funds by about 6% per year during non-crisis periods. Focusing on funds that offer favorable redemption terms to investors, Teo (2011) finds that the associated high rewards induce such liquid funds to take on excessive liquidity risk, thereby exacerbating fire sale risks. Brandon and Wang (2013) analyse the impact of liquidity risk on equity hedge fund performance. They observe that the liquidity risk betas are significantly positive and the superior performance these hedge fund portfolios generate becomes insignificant after accounting for liquidity risk. Cao et al. (2013) further claim that hedge fund managers appear to time market liquidity, increasing their exposure to market liquidity risk when market liquidity is high, and top liquidity timing funds subsequently outperform bottom timers. One important role of hedge funds is market liquidity provision. Jylhä et al. (2014) show that hedge funds, especially large funds and those that offer less frequent redemptions, typically supply liquidity to the stock market and earn positive returns from such liquidity provision. However, during liquidity-related crises, hedge funds demand liquidity. Using data on institutional transactions, Franzoni and Plazzi (2013) find that hedge funds' liquidity provision is positively associated with aggregate funding conditions, and that its sensitivity to funding liquidity is stronger than for other institutional investors. In addition, a decrease in liquidity provision by hedge funds often precedes a reduction in market liquidity, while such an effect is absent for other institutions.

Overall, our analysis of the indirect effects of banking regulation on unregulated market players, hedge funds, contributes to a better understanding of the network of relationships which exist between hedge funds and the banking sector. Following implementation of the Volcker Rule, hedge funds in general experience outflows, take less liquidity risk, and relocate their market-making activities from a less to a more liquid segment of the equity market. Those funds that have contractual business connections with LCFIs appear to be the most affected by the Volcker Rule. Importantly, the effect is more strongly pronounced for non-directional hedge funds, which trade on relative security mispricing, implying that the Rule's introduction may have adverse consequences for market efficiency.

2 Research Design

This section develops testable hypotheses related to the hedge fund 'liquidity circle'. We begin by discussing the changes in overall market liquidity around the implementation of the Volcker Rule, then proceed to analyse the effect of the Rule on hedge fund funding liquidity, and finally discuss hedge fund exposure to market liquidity and liquidity provision.

2.1 Implementation time line of the Volcker Rule

The Volcker Rule was first publicly endorsed by President Obama on January 21, 2010 and was enacted as part of the Dodd-Frank Wall Street Reform and Consumer Protection Act on July 21, 2010, codified in Section 13 of the Bank Holding Company Act of 1956. On January 18, 2011, the Financial Stability Oversight Council made recommendations for implementing the Volcker Rule. Board of Governors of the Federal Reserve System Board (Board), the Federal Deposit Insurance Corporation (FDIC), the Office of the Comptroller of the Currency (OCC), the Securities and Exchange Commission (SEC), and the Commodity Futures Trading Commission (CFTC) then worked jointly in formulating a proposal before releasing a version for public comments on October 11, 2011. Under the Dodd-Frank financial reform law, the regulations went into effect on July 21, 2012, but a two-year conformance period for banks to fully conform its activities and investments to the requirements of the Volcker Rule was provided. On December 10, 2013, the Volcker Rule regulations were approved by all above five financial regulatory agencies. The final regulations were published in the Federal Register on January 31, 2014, and became effective on April 1, 2014.

The largest banking entities (with at least $50 billion in trading assets) are required to report quantitative measurements to regulators from July 1, 2014 and to become fully compliant with the Volcker Rule by July 21, 2015. However, extensions continued for banks to exit illiquid investments. On December 18, 2014, the Federal Reserve extended the Volcker Rule's conformance period for 'legacy covered funds' until July 21, 2016, and extended the period further to July 21, 2017, which is the final of the three one-year extensions that the Board is authorized to grant. On the deadline day, July 21, 2017, the Board, the FDIC and the CFTC, said no enforcement action would be taken with respect to qualifying foreign funds until after July 21, 2018. The no-action position was extended in 2018 to July 21, 2019 and further extended in 2019 to July 21, 2021.

Figure 2 depicts all the events. Despite all the extensions granted to banks to become fully compliant to the Rule, they were required to endeavour to implement the new rules from April 1, 2014, and from July that year their efforts were monitored. Thus, we expect that any adjustments in bank-hedge fund relations and resulting changes in hedge fund trading decisions will be pronounced after April 2014. Thus, throughout the main analysis we concentrate on

two sub-periods: the "Before the Rule" period ends in March 2014, and the "After the Rule" period begins in April 2014.

At the same time since the information of the eventual need to comply with the regulations was available as early as 2010, in the later part of the paper we additionally consider any changes in hedge fund liquidity exposure and provision during the implementation phase from July 2010 to March 2014.

[Figure 2 in here]

2.2 Equity market liquidity around the implementation of the Volcker Rule

The Volcker Rule prohibits banks from engaging in proprietary trading, although banks' underwriting and market-making activities are exempt from the restrictions. In reality, however, it is often difficult to disentangle proprietary trading and market making (Chow and Surti, 2011). Consequently, the affected banks greatly reduce their trading activities. The implementation of the Volcker Rule adversely affects both the scale and quality of market-making services that banks provide to investors, resulting in a deterioration in market liquidity (Duffie, 2012). There is a reduction in the size of banks' trading books (Keppo and Korte, 2016), and the liquidity of the bond market is found to deteriorate during periods of market stress (Bao et al., 2018).

In this section we compare different liquidity measures in the two sub-periods before "Before the Rule" and "After the Rule". Obviously, the changes in market liquidity, if any, cannot be solely attributed to the Volcker Rule, as there are other relevant overlapping events which can impact market liquidity.[6] Thus, we do not intend to establish causality between the Volcker Rule implementation and the changes in market liquidity, but rather describe the playing filed, in which hedge funds, banks and other market participants make their decisions.

For each of the sub-periods, we compute several market liquidity measures. First, we compute the Amihud (2002) illiquidity measure for all stocks from the Center for Research in Security Prices (CRSP) database ($Amihud_{i,t}$) using daily returns ($r_{i,t}$) and daily trading volumes ($Vol_{i,t}$) and three month estimation windows, with N_d being the number of daily observations during the estimation period.

$$Amihud_{i,t} = 1/N_d \sum_{\tau=1}^{N_d} |r_{i,t-\tau}|/Vol_{i,t-\tau} \tag{1}$$

[6] One of the prominent events, for example, is the US debt ceiling crisis, which began in January 2013, and led to the need to legally raise the US debt limit. It was initially ended in October 2013, following the Continuing Appropriations Act. In February 2014 the ceiling was suspended until March 2015.

As our second and third liquidity measures, we use the Pástor and Stambaugh (2003) monthly innovations in aggregate market liquidity (LIQ_t) and traded liquidity measure ($TradeLiq_t$).[7] The aggregate market-wide liquidity measure encompasses the idea that a larger trading volume induces greater price changes and subsequent price reversals, when liquidity is low. Intuitively, it captures the average strength of individual stock price reversions following large trades. The traded liquidity measure is the return on a long-short equity portfolio, which goes long in stocks with the highest exposure to the innovations in aggregate market liquidity and shorts stocks with the lowest exposure.

Next, for each stock in the CRSP database, we compute the relative bid-ask spread (in percentages) using daily prices ($BAS_{i,t}$).

Finally, we compute the return from providing liquidity (Rlp_t) following Jylhä et al. (2014). The measure is calculated as a return to a zero-investment contrarian long-short trading strategy, utilising short-term return reversals. Specifically, each day it estimates cross-sectional regression that relates 5-day return to twenty lagged daily returns and a set of controls. Jylhä et al. (2014) show that the average loadings on the lagged returns are negative, indicating price reversals. The expected 5-day returns are then calculated. Every day a long position is opened in stocks with a positive expected 5-day return and a short position taken in stocks with a negative expected 5-day return. The positions are held for five days and then closed. The daily returns are calculated as the average returns of all opened positions on that day, and then the measure uses monthly averages to obtain the final value of the measure.

We compare the distributional properties of all these measures before and after the implementation of the Volcker Rule. We expect equity market liquidity to deteriorate, although the effect may be milder than that evident for the more illiquid and less transparent bond market.

2.3 The Volcker Rule and hedge funds' flow-performance sensitivity

Apart from banning proprietary trading, a second important ingredient of the Volcker Rule is that it prohibits banking entities from sponsoring or investing in hedge funds. As such, hedge funds that receive investment funding from banking entities, especially from those US banking entities targeted by the Volcker Rule, may face outflows following the Dodd-Frank Act. Cumming et al. (2017) analyze the impact of the Dodd-Frank Act on hedge fund performance, risk and fund flows. They find that relative to non-US hedge funds, the alpha of the US domiciled hedge funds declines and their outflows increase following implementation of Dodd-Frank. We conjecture that the Volcker Rule, which explicitly limits hedge funds' relationships with banking entities, may have an even more pronounced effect on the hedge fund industry. Specifically, we expect hedge funds to experience a reduction in funding flows after the Volcker Rule, especially those funds with prior direct investments from LCFIs.

[7] This data is available at https://faculty.chicagobooth.edu/lubos.pastor/research/.

The Volcker Rule is also likely to affect hedge funds' flow-performance relations. The Volcker Rule increases general uncertainty in the overall market, and the hedge fund industry in particular.[8] Uncertainty relating to fund performance and diffuse beliefs both serve to magnify investor responses to fund performance. Chevalier and Ellison (1997) find that funding flows of younger funds are more sensitive to performance than those of mature funds, which suggests that beliefs about funds with limited track records are more diffuse. Similarly, Bollen (2007) claims that such diffuse prior beliefs about the effectiveness of a socially responsible investment strategy can drive a stronger flow-performance relation for socially responsible funds. Higher uncertainty after the Volcker Rule may further increase investors' aversion to downside risk. The literature indicates that investors use past performance to identify funds with lower downside risk and exhibit a differential response to performance according to the stage of the market cycle. For example, De Andrade Jr (2009) finds that investors invest more heavily in mutual funds that perform well in declining markets. Artavanis et al. (2018) further show that investors' sensitivity to downside risk significantly increases following Lehman Brother's bankruptcy. Applying the same reasoning to hedge funds, we should observe that their flow-performance sensitivity becomes stronger after the Volcker Rule.

Franzoni and Giannetti (2019) document that financial-conglomerate-affiliated hedge funds exhibit more stable funding and a lower flow-performance sensitivity. However, following the Volcker Rule, hedge funds with prior investment from large banks may need to seek other funding sources, leading to an even further increase in the flow-performance sensitivity for this group of funds as bank investment and sponsorship is withdrawn.

The above analysis informs our set of hypotheses on the impact of the Volcker Rule on hedge funds' flows and flow-performance relationships.

Following implementation of the Volcker Rule:
H1(a) hedge funds' flows decline,
H1(b) their flow-performance sensitivity increases,
H1(c) the effect is especially strong for funds connected to LCFIs.

We test these hypotheses using the following panel regression for fund flows:

$$\begin{aligned} Flow_t^i =& \alpha + (\beta_0 + \beta_1 Volcker_t + \beta_2 Connect_t^i + \beta_3 Volcker_t Connect_t^i) \cdot Ret_{t-12}^i + \\ & \gamma_0 Volcker_t + \gamma_1 Connect_t^i + \gamma_2 Volcker_t Connect_t^i + \delta Controls_t^i + \varepsilon_t^i \end{aligned} \tag{2}$$

where $Flow_t^i$ is the flow for hedge fund i in month t measured using Equation (3), where AUM_t^i denotes the assets under management of fund i at the end of month t, and Ret_t^i is the reported

[8]See, for example, Charles K. Whitehead. The Volcker Rule and Evolving Financial Markets. *Harvard Business Law Review*, 2011.

return for fund i during month t.

$$Flow_t^i = \frac{AUM_t^i - AUM_{t-1}^i(1 + Ret_t^i)}{AUM_{t-1}^i} \tag{3}$$

We also use an alternative measure of funding flows in Equation (2) to measure long-term flow, $\overline{Flow^i}_{t:t+11}$, the average monthly flow for hedge fund i from month t to $t + 11$. We capture the pre- and post- Volcker Rule phases with a dummy variable $Volcker$, taking a value of 1 after April 2014, and 0 otherwise, following an identical sample division as our market liquidity measure in Section 2.2.

In order to precisely identify the effect of the Volcker Rule on hedge funds, we ideally require detailed information on banks' investments into hedge funds. Such data are, however, not available. Thus, we have to resort to using an indirect proxy for the potential investment of banks into hedge funds. We construct a dummy variable *Connect* that measures hedge fund's connection to US-based LCFIs, the main targets of the Volcker Rule. The variable takes a value of 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund, and zero otherwise.

We identify the US-based LCFIs as those eight US banks in the list of Systemically Important Financial Institutions (SIFI) namely: the Bank of America Corporation, JP Morgan Chase & Co., Citigroup Inc., Wells Fargo & Company, Goldman Sachs Group, Morgan Stanley, Bank of New York Mellon Corporation, and State Street Corporation (Financial Stability Board, 2011). In our sample, 30% of hedge funds are connected to these banks. The implicit assumption we are making here is that those funds with business connections to LCFIs are also more likely to receive larger direct investments from LCFIs. If effect, we are undertaking a joint hypothesis test: the validity of our proxy and the existence of the effect. We create an additional dummy variable, *Prime*, to capture the prime brokerage relations of hedge funds. The variable equals to 1 if a US-based LCFI is a prime broker of a hedge fund, and zero otherwise.

The group of unconnected funds does not include only funds using unknown prime brokers, custodians and advisors. Those funds which are connected to non-US based LCFIs will be part of the unconnected sub-group, as the Volcker Rule does not directly target these LCFIs. In particular, 20% of hedge funds in our sample are connected to the following eight non-US banks LCFIs: HSBC Bank plc, UBS Group AG, Deutsche Bank AG, Credit Suisse Group AG, BNP Paribas S.A., Barclays plc, Banco Santander S.A., and Société Générale S.A.

In choosing the other control variables, we closely follow Ding et al. (2008) and Kolokolova and Mattes (2018). Ret_{t-12}^i is the average return for fund i over the past 12 months. STD_{t-12}^i is the standard deviation of monthly returns over the past 12 months; $lnAUM_{t-1}^i$ is the natural logarithm of hedge fund dollar assets in month $t-1$; Age_{t-1}^i is the age of a hedge fund at month

$t-1$; HWM^i equals 1 if a high water market provision is present, and 0 otherwise; $MgtFee^i$ is the management fee a fund charges; $IncFee^i$ is the incentive fee a fund charges; $Leverage^i$ equals 1 if a fund uses leverage, and 0 otherwise; $Redemption^i$ is the total redemption period, which is the sum of redemption and advance notice periods (measured in days); $LockUp^i$ is the fund's lockup period (measured in months), and $StyleEffect_t^i$ is the average flow into hedge funds from the same style category as fund i.

Our analysis predicts β_1 and β_3 to be positive and γ_0 and γ_2 to be negative, meaning that flow-performance sensitivity increases and hedge funds experience funding outflows after the Volcker Rule, especially those funds connected to US LCFIs. If funds with LCFI connections have access to a more stable funding environment and are able to attract higher flows of capital before the Volcker Rule, we expect β_2 to be negative and γ_1 to be positive.

2.4 The Volcker Rule and hedge funds' market liquidity exposure

This section analyses both whether and how hedge funds adjust the liquidity risk of their portfolios in response to the changing environment of lower market liquidity and weaker access to new capital after the Volcker Rule. According to Cao et al. (2013), hedge fund managers reduce their funds' exposure to market liquidity if market liquidity deteriorates. This being the case, we should observe that hedge funds decrease their exposure to the market liquidity factor after the Volcker Rule's implementation. This channel should systematically affect all hedge funds, regardless of whether or not they have a US-based LCFI connection.

As previously discussed, prohibiting LCFIs from sponsoring and investing in hedge funds may result in outflows from funds with large existing investments from these institutions. In response, the potentially affected funds may restructure their portfolios towards more liquid assets in advance, enabling them to meet redemptions if required. Thus, connected funds can be expected to reduce their exposure to market liquidity even further.

Such adjustments are likely to be more pronounced for funds with a diminished ability to retain capital in adverse situations, such as those with relatively poor past performance, high leverage and low lockup and redemption restrictions. Indeed, Franzoni and Plazzi (2013) document that hedge funds with higher leverage, more illiquid assets, lower reputational capital, and lower share restrictions are those most exposed to funding constraints. Kruttli et al. (2018) show that small, poorly performing hedge funds, and those with fewer prime brokers and having a large share of illiquid OTC trades are the entities most negatively impacted by the 2016 Deutsche Bank liquidity shock. Another possible reason that these funds are more affected is that during the process of Volcker Rule implementation, banks will gradually sever their relationship with covered funds in order to conform to the regulation. They are likely to start with those funds, where it is easier to terminate contractual relations (e.g. funds with short redemption period) and funds which are less profitable, attempting to maintain their

relationships with more profitable funds until legally prohibited from doing so. This leads to our next set of hypotheses:

Following implementation of the Volcker Rule:
H2(a) hedge funds reduce their exposure to market liquidity,
H2(b) the effect is stronger for connected funds with a lower ability to retain capital.

The regression models we estimate to test these hypotheses are as follows:

$$Ret_t^i = \alpha + \sum_{k=1}^{7} \beta_k F_{k,t} + (\gamma_0 + \gamma_1 Volcker_t + \gamma_2 Connect_t^i + \gamma_3 Volcker_t \cdot Connect_t^i) \cdot LIQ_t + \varepsilon_t^i \quad (4)$$

$$\begin{aligned} Ret_t^i = \alpha &+ \sum_{k=1}^{7} \beta_k F_{k,t} + \delta X_{t-12}^i + \varepsilon_t^i \\ &+ (\gamma_0 + \gamma_1 Volcker_t + \gamma_2 Connect_t^i + \gamma_3 Volcker_t \cdot Connect_t^i) \cdot LIQ_t \\ &+ (\eta_0 X_{t-12}^i + \eta_1 Volcker_t \cdot X_{t-12}^i + \eta_2 Connect_t^i \cdot X_{t-12}^i + \eta_3 Volcker_t \cdot Connect_t^i \cdot X_{t-12}^i) \cdot LIQ_t \end{aligned} \quad (5)$$

where Ret_t^i is hedge fund i's return in month t, $F_{k,t}$ are the 7 Fung-Hsieh factors consisting of two equity-oriented risk factors, namely the Standard & Poors (S&P) 500 index total return (MKT) and the difference between the Russell 2000 index total return and the S&P 500 total return (SMB), two bond-oriented risk factors, namely the change in the 10-year Treasury constant maturity yield ($TERM$) and the change in Moody's Baa yield over the 10-year Treasury constant maturity yield ($CREDIT$), and three trend-following momentum risk factors, namely, $PTFSBD$ (bond), $PTFSFX$ (currency) and $PTFSCOM$ (commodity).[9] We use the Pástor and Stambaugh (2003) monthly innovations in aggregate market liquidity measure to capture market liquidity (LIQ). This measure is widely used in the literature (see, for example, Teo, 2011; Jylhä et al., 2014).

In Equation (5), we incorporate fund characteristics as further controls. X denotes one of six fund characteristics in turn: $Weak$ is a dummy variable that equals 1 for funds with returns below the median in each hedge fund category; $Lever$ is a dummy variable that equals 1 if a fund uses leverage; $Young$ is a dummy variable that equals 1 if a fund's age is below the median across all live funds; $Small$ is a dummy variable that equals 1 if a fund's assets under management are below the median; $Lock$ is a dummy variable that equals 1 for funds with lock-up periods; $LowRed$ is a dummy variable that equals 1 for funds with a total redemption period, which is the sum of redemption and advance notice periods, below the median. These characteristics

[9]These factors may be downloaded from http://faculty.fuqua.duke.edu/ dah7/DataLibrary/TF-FAC.xls.

are constant within a specific month and are based on prior 12 months information.

In Equation (4), the key variable of interest is γ_1. We expect γ_1 to be negative, indicating that hedge funds reduce their market liquidity exposure following the Volcker Rule. We expect γ_2 to be positive, denoting that hedge funds that have a connection with LCFIs are generally more exposed to market liquidity. The expectation we place on the sign of γ_3 cannot be determined a priori, as it potentially depends on fund characteristics. In Equation (5), after controlling for fund characteristics, we expect η_3 to be negative, meaning that connected funds unable to retain capital under adverse conditions, reduce their exposure to market liquidity risk subsequent to the Volcker Rule.

2.5 The Volcker Rule and hedge funds' supply of liquidity

In this section, we analyse how the implementation of the Volcker Rule influences hedge funds' willingness to supply liquidity. Jylhä et al. (2014) argue that in periods of poor market liquidity and favourable funding conditions, hedge funds' propensity to supply liquidity increases. Our previous analysis suggests that market liquidity deteriorates subsequent to the Volcker Rule as a result of a reduction in banks' market-making activities, which should increase hedge funds' propensity to supply liquidity. This phenomenon affects all hedge funds, regardless of whether or not they are connected to banking entities. Indeed, Duffie (2012) maintains that non-bank broker-dealers play a more important role in providing market-making services and market liquidity after the Volcker Rule.

Hedge funds that have significant investments from US banks experience funding outflows and face higher funding liquidity risk after the Volcker Rule, which reduces their incentives to trade illiquid assets. Thus, one the one hand, such funds may be less likely to provide liquidity to the market. On the other hand, in response to a decline in returns attributable due to not holding illiquid assets, these "connected" funds may now seek alternative mechanisms to enhance returns, including moving into market-making/liquidity provision activities. Their connection to LCFIs (which may previously have undertaken such activity but are retrenching from it after Volcker Rule implementation) may facilitate easier access to the requisite information for engaging in these activities through their advisory roles. These banks are less likely to share their expertise with their connected hedge funds before the Rule, since they will use it to support their own trading activities. We believe that this relationship may grant an informational advantage to connected over non-connected funds when moving into these areas of market making activity. Therefore, connected funds, in particular, will enhance their liquidity provision subsequent to the Volcker Rule. However, facing conflicting incentives, connected funds may choose not to uniformly increase their liquidity provision. Instead, they may increase their market-marking activities in a segment of the more liquid stocks, utilising information advantage generated by banking connections, but decrease their market-making activities in a

segment of less liquid stocks following less certain funding conditions. Those funds that are less able to retain investment capital due to poor past performance or lax share restrictions may also find it more difficult to accumulate sufficient capital to undertake such market-making activities, so we expect them to be less likely to increase their liquidity provision. This suggests:

Following implementation of the Volcker Rule:
H3(a) hedge funds increase liquidity provision to the market,
H3(b) the effect is stronger for connected funds in a more liquid market segment,
H3(c) the effect is weaker for connected funds with a lower ability to retain capital.

We test the hypotheses using the following panel regression specifications, following Jylhä et al. (2014):

$$Ret_t^i = \alpha + \sum_{k=1}^{7} \beta_k F_{k,t} + (\gamma_0 + \gamma_1 Volcker_t + \gamma_2 Connect_t^i + \gamma_3 Volcker_t \cdot Connect_t^i) \cdot Rlp_t + \varepsilon_t^i \quad (6)$$

$$\begin{aligned} Ret_t^i = \alpha &+ \sum_{k=1}^{7} \beta_k F_{k,t} + \varepsilon_t^i \\ &+ (\gamma_0 + \gamma_1 Volcker_t + \gamma_2 Connect_t^i + \gamma_3 Volcker_t \cdot Connect_t^i) \cdot Rlp_t + \delta X_{t-12}^i \\ &+ (\eta_0 X_{t-12}^i + \eta_1 Volcker_t \cdot X_{t-12}^i + \eta_2 Connect_t^i \cdot X_{t-12}^i + \eta_3 Volcker_t \cdot Connect_t^i \cdot X_{t-12}^i) \cdot Rlp_t \end{aligned} \quad (7)$$

where Rlp is the return from providing liquidity which we calculate following Jylhä et al. (2014), as described in Section 2.2. A similar approach and methodology is adopted by, for example, Khandani and Lo (2011) and Nagel (2012). The other variables are defined in Section 2.4 for Equations (4) and (5).

We first run the regression using our general Rlp factor, and then we consider two sub-factors, namely, the return from providing liquidity for more liquid stocks Rlp^{Liquid}, and the return from providing liquidity for less liquid stocks $Rlp^{Illiquid}$. To construct these sub-factors, we follow the same procedure as in Jylhä et al. (2014), but use sub-samples of stocks with the Amihud illiquidity measures below (for liquid stocks) or above (for illiquid stocks) the median value as of the sorting date.

We expect γ_1 to be positive in equation (6), indicating that hedge funds provide more liquidity to the market after the Volcker Rule, and γ_3 to be positive if hedge funds connected to LCFIs enhance their liquidity provision after the Rule. γ_3 should be higher when using the Rlp^{Liquid} factor, if hedge fund concentrate their liquidity provision in a more liquid market segments. After controlling for fund characteristics in Equation (7), we expect η_3 to be negative, indicating that those connected funds who experience difficulty in retaining capital in adverse

economic conditions reduce their liquidity provision to the market following the Volcker Rule, in comparison to connected funds who are more able to retain their capital.

3 Data

We collect our hedge fund data from the Lipper TASS and Eurekahedge databases, which include a history of returns as well as a series of hedge fund characteristics and information on affiliated companies. The original sample runs from January 1990 to December 2015 and includes 36,353 funds. These funds are roughly evenly split between TASS and Eurekahedge and many funds belong to only one database, highlighting the advantage of obtaining data from more than one source. We exclude duplicate funds by only keeping fund records with the longest history in either TASS or Eurekahedge. Of the remaining 27,910 hedge funds, 15,580 (12,330) are from TASS (Eurekahedge). We further restrict our sample to comprise funds with at least 36 return observations, and report their returns in U.S. dollars. To address a potential backfilling bias, we exclude the first 12 months of returns for each fund. We also filter out any observations before 1994 to control for survivorship bias, and exclude Funds of Funds. The final sample includes 8,686 funds and our sample period extends from January 1994 to December 2015. We combine the hedge fund style classifications of the two databases and classify funds into 10 broad categories: Long/Short Equities, Equity Market Neutral, Fixed Income, Relative Value, Event Driven, Global Macro, Managed Futures, Emerging Markets, Multi-Strategy and Others (Table 1). Following Ilerisoy et al. (2017), we further divide hedge funds into three broad investment strategy categories: directional funds, non-directional funds, and semi-directional funds.

[Tables 1, 2 and 3 in here]

Tables 2 and 3 report summary statistics for hedge fund monthly returns and flows. Panel A reports the statistics for the full sample, and Panel B reports the statistics by investment style. The statistics within a style are equally weighted averages across all funds in the same style category. The average return over the complete sample is 0.563% per month. The most profitable funds were those in the Multi-Strategy category with the average return of 0.740% per month closely followed by Equity Market Neutral funds with the average return of 0.739%. Fixed Income funds have the lowers average returns of 0.385% per month, but they also exhibit the smallest return volatility of 2.071% per month. Event Driven funds have the highest mean to standard deviation ratio of 0.20. The flows seem to approximately follow the return patterns, with Equity Market Neutral, Event Driven, and Multi Strategy funds receiving, on average, strong inflows, whereas Global Macro, Long/Short Equities and Emerging Markets funds on average experience outflow during our sample periods. There is still substantial heterogeneity in terms of the returns and flows of individual hedge funds.

Table 4 reports the descriptive statistics of the other hedge fund characteristics. The average fund size is approximately $270 million and the average fund age after excluding the first 12 months is less than 3 years. Just over half of the funds report the use of leverage. The average management and performance fees are 1.46% and 16%, respectively. Lock-up and redemption period average around 3 months, with an average subscription period of around 1 month. 32% of hedge funds use one of the US-based LCFI as a prime broker, and 30% of funds have different types of connections with the US-based LCFIs. 16% of funds use non-US LCFI as a prime broker and 22% have other connections with non-US LCFIs.

Comparing the characteristics of connected and unconnected funds (Panels B and C), one can see that there are no substantial differences between these two groups of funds, except from fund size. On average connected funds have USD 389 million under management, whereas unconnected funds have USD 221 million.

[Table 4 in here]

4 Empirical results

4.1 Market liquidity around the Volcker Rule

Table 5 reports the summary statistics of the Amihud (2002) illiquidity measure, bid-ask spread, Pástor and Stambaugh (2003) innovations in the aggregate market liquidity and traded liquidity factors, and Jylhä et al. (2014) returns from liquidity provision pre- and post- the Volcker Rule.

The overall picture suggests that the equity market liquidity deteriorates during the "After the Rule" period with the trading environment becoming more volatile and uncertain. The distributions of bid-ask spreads, Amihud illiquidity and the returns from providing liquidity undergo significant changes after the implementation of the Volcker Rule, as indicated by the values of the Kolmogorov-Smirnov and Cramer-von Mises statistics.

The average stock Amihud measure increases significantly. Standard deviation and skewness also increase dramatically, suggesting that illiquidity of less liquid stocks becomes even higher in the second period, and there are relatively more very illiquid than very liquid stocks. Similarly, the average bid-ask spread increases significantly, and it exhibits higher volatility, greater skewness and kurtosis.

The innovations in aggregate market liquidity and the traded liquidity measure become more left-skewed (with skewness changing from 0.28 pre-Rule to -0.12 post-Rule for the innovations and from 0.43 to -0.81 for traded liquidity), indicating a relatively higher proportion of days

in which market liquidity deteriorates. However, we cannot reject the hypotheses that the distributions remain the same.

Importantly, the average returns from liquidity provision turn negative in the post-Rule sub-sample and also become more volatile. This indicates that the 5-day contrarian strategy that works successfully before the implementation of the Volcker Rule, fails to deliver positive returns in the second sub-period. It appears to take longer than five trading days for any price reversals to be realised in the second sub-period which suggests lower market liquidity and a lack of arbitrage capital.

[Table 5 in here]

4.2 Hedge fund flows and the Volcker Rule

We report the estimation results for Equation (2) capturing the impact of Volcker Rule implementation on investor flows to hedge funds in Table 6. The first three columns present the results for short-term monthly flows, and the next thee columns document the results for long-term average annual flows. Columns (1) and (4) use prime brokerage connections to large banks *Prime*, columns (2) and (5) use the business connections variable *Connect* to proxy for bank direct investments into hedge funds, and columns (3) and (6) incorporate both these variables.

In relation to fund flows, after the Volcker Rule hedge funds experience significantly lower average flows, as indicated by the significantly negative coefficients on $Volcker$ (γ_0) in all columns, supporting our hypothesis $H1(a)$. The γ_1 coefficient is positive and highly significant for the *Connect* variable in all specifications. The impact of *Prime* is not statistically significant in all the specifications but one. It is positive and significant at the 10% level in column (6) for the long-term flows. This indicates that it is the other contractual relationship with LCFIs rather than the prime brokerage relationship which generates stable and detectable inflows of capital prior to the Volcker Rule, supporting our assumption that *Connect* also captures the likelihood of LCFIs direct investments into hedge funds. These funds also experience a stronger funding flow decline following the Volcker Rule implementation as compared to the funds connected to LCFIs only through a prime brokerage link. The γ_2 coefficient for $Volcker \cdot Connect$ is always negative and significant at the 1% level for both long-term and short-term flows. The coefficients for $Volcker \cdot Prime$ are not significant for short-term flows, and they become positive and significant for long-term flows.

Moving to the flow-performance sensitivity results, the coefficients (β_0) on *Ret* are positive and significant at a 1% level in all columns, suggesting a strong positive flow-performance relation for hedge funds which is consistent with existing literature. The coefficient β_1 for the interaction term $Ret \cdot Volcker$ is significantly positive for the long-term flow, signifying

that hedge funds flow-performance sensitivity increases after the Volcker Rule implementation. This effect is, however, driven largely by those funds with contractual connections to LCFIs, a finding which is consistent with our hypothesis $H1(c)$. The corresponding loading β_3 on the interaction term, $Ret \cdot Volcker \cdot Connect$, is positive with a value 0.08 for long-term flows, significant at the 1% levels respectively, whereas $Ret \cdot Volcker \cdot Prime$ is not significant for the long-term flow.

The effects of other control variables are consistent with previous findings. Funds with high return volatility, larger size, older age, and those using leverage attract lower inflows, while funds with a high-water mark provision and higher incentive fees attract more inflows. Finally, capital flows into the same-style category positively impact individual fund flows.

[Table 6 in here]

4.3 Hedge funds' liquidity exposure and the Volcker Rule

Table 7 reports the estimation results for Equation (4) analysing changes in hedge funds' exposure to market liquidity in response to Volcker Rule implementation.[10] The significantly positive coefficient γ_0 on LIQ in all columns indicates that hedge funds exhibit a positive and significant loading on the market liquidity factor, a finding which is consistent with prior literature (Sadka, 2010; Teo, 2011). Subsequent to the Volcker Rule, hedge funds significantly decrease their exposure to market liquidity as the coefficient γ_1 on the interaction term $LIQ \cdot Volcker$ is significantly negative in all specifications, thereby supporting our hypothesis $H2(a)$.

In terms of LCFI connections, the significantly positive γ_3 on $Liquidity \cdot Connect$ suggests that hedge funds that have business links to LCFIs and are likely to receive their direct investments (as supported by the results from the previous section) are more exposed to market liquidity prior to the Volcker Rule. However, the impact of the Volcker Rule is also more pronounced for such funds, with γ_3 being negative and significant, which may be attributable to the lower funding flows after the Volcker Rule. The $LIQ \cdot Prime$ and $LIQ \cdot Volcker \cdot Prime$ coefficients are not statistically significant, indicating that the prime brokerage relationship does not change the general Volcker Rule effects.

[Table 7 in here]

How do those hedge fund characteristics which relate to their ability to retain capital influence their exposure to market liquidity? Since the effect of the Volcker Rule is more pronounced for funds that have business connections other than prime-brokerage relations with

[10]The results we discuss in this section use the innovations in the aggregate liquidity factor. They remain qualitatively unchanged if the traded liquidity factor is used. The latter results are tabulated in Appendix A.

LCFIs, we use only the variable *Connect* in this analysis. We report the results for *Prime* in Appendix B. For expositional clarity, we omit the coefficients on the Fung and Hsieh 7 factors. The key coefficient of interest is η_3 in Equation (5), capturing the effect of the interaction terms $LIQ \cdot Volcker \cdot Connect \cdot X$.

The estimation results in Table 8 indicate that the previously discussed reduction in market liquidity exposure by connected funds is primarily driven by funds with poor performance. The corresponding coefficient η_3 in column (1) of -8.977 is significant at the 5% level, while γ_3 for $LIQ \cdot Volcker \cdot Connect$ is not statistically significant, supporting our hypothesis $H2(b)$. In all other columns, when we do not control for hedge fund past performance, γ_3 is always negative and significant. Interestingly, young connected funds reduce their liquidity exposure less strongly than older funds following the regulation. The η_3 coefficients in other columns, which also captures funds with the ability to retain capital, are negative but not statistically significant. This suggests that the decision to withdraw capital by LCFIs after the rule depends primarily upon past hedge fund performance, with other factors playing a minor role.

[Table 8 in here]

We now construct sub-samples of funds across different investment categories to determine whether the Volcker Rule has heterogeneous effects across hedge fund strategies. First, we classify funds according to whether they are arbitrage (non-directional), clearly directional or semi-directional, as previous studies find there are significant differences between these types of funds which are potentially relevant for regulatory effects. Agarwal and Naik (2000) show that the performance of directional funds exhibit a high correlation with the market returns, a feature absent from non-directional (market-neutral) funds. Hence, the two categories of funds have significantly different risk exposures. Similarly, McGuire et al. (2005) find that the performance of market neutral funds is independent of the direction of the market and their exposure to fixed income market risk factors is more important for such funds. These results inform our expectation that the loss of market liquidity resulting from the reduction in banks' market-making activities has a more pronounced effect on directional funds.

Table 9 indicates that both directional and non-directional funds exhibit a positive and significant loading on the market liquidity risk factor, with the coefficient of LIQ larger in magnitude for directional funds. The coefficients on semi-directional funds is also positive albeit insignificant. After the Volcker Rule, all categories of funds significantly decrease their exposure to market liquidity with the measured impact much stronger for directional funds exhibiting a coefficient of -14.706 which is significant at the 1% level. The significantly positive coefficient on $LIQ \cdot Connect$ in the second column suggests that non-directional funds having other contractual connections with LCFIs are generally more exposed to the market liquidity risk factor. However, this effect is offset following the Volcker Rule's implementation.

[Table 9 in here]

We further classify funds according to their investment strategies. Prior literature shows that substantial differences exist across hedge fund strategies. Klaus and Rzepkowski (2009) find that Fixed Income and Convertible Arbitrage funds, which are among the most leveraged funds, perform extremely poorly during the peak of the 2008 crisis. Ang et al. (2011) show that the average gross leverage of Relative Value funds is around 3 times higher than that of Equity and Event-Driven funds. Sadka (2010) argues that Long/Short Equity, Multi-Strategy and Emerging Markets are the top three performing fund indices with the highest market liquidity loadings. Jylhä et al. (2014) find that funds in the Equity Market Neutral and Event-Driven categories are more like to supply market liquidity.

Table 10 indicates that all styles have significant positive exposure to market liquidity risk with the exception of Multi-Strategy. The largest coefficient, 13.713, is found for the Emerging Markets funds. After the Volcker Rule, hedge funds significantly decrease their exposure to market liquidity, especially those funds in the Emerging Markets and Managed Futures categories. In addition, a more pronounced impact is found for connected funds in the Equity Market Neutral, Relative Value, Multi-Strategy and Others styles, with the coefficient γ_3 on the interaction term $LIQ \cdot Volcker \cdot Connect$ being significantly negative. As Equity Market Neutral and Relative Value styles exploit price differences between related financial instruments, thereby reducing asset mispricing, one implication of this result is that market liquidity and efficiency may be adversely affected by hedge funds reducing their liquidity exposure. The only group of hedge funds which do not reduce their liquidity exposure after the implementation of the Volcker Rule are the connected funds adopting the Global Macro style.

[Table 10 in here]

4.4 Hedge fund liquidity provision and the Volcker Rule

Table 11 reports the estimation results from Equation (6) capturing the impact of Volcker Rule implementation on the provision of liquidity to different segments of the equity market by hedge funds. The significantly negative coefficient γ_0 on Rlp in columns (1) to (3) indicates that hedge funds customarily demand liquidity. This finding is consistent with those in Puckett and Yan (2011) and Franzoni and Plazzi (2013), who argue that funds with higher interim trading skills experience greater funding costs and demand market liquidity. Moreover, Jylhä et al. (2014) and Franzoni and Plazzi (2013) show that hedge funds demand liquidity when aggregate economic conditions deteriorate. However, splitting the Rlp factor into liquid (columns (4)-(6)) and illiquid (columns (7)-(9)) stocks reveals a more subtle result, namely that hedge funds used to demand liquidity for liquid stocks, but supply it for illiquid ones (positive and highly significant γ_0 in columns (7)-(9)).

The coefficient γ_1 on the interaction term $Rlp{\cdot}Volcker$ in columns (1) to (3) is significantly positive, supporting our hypothesis $H3(a)$ that hedge funds are a source of increased liquidity provision following the Volcker Rule. However, this is not the case for less liquid stocks. The negative γ_1 in columns (7) to (9) indicates a reduction in liquidity provision by hedge funds to less liquid stocks after Volcker Rule implementation.

Consistent with the intuition underlying $H3(b)$, this effect is more pronounced for funds that have contractual connections with large banks. However, once again the effect operates in opposite directions for liquid and illiquid stocks. γ_3 is positive and significant in columns (5) and (6), suggesting that hedge funds having contractual relations with LCFIs engage more in market-making activity for liquid stocks after the Volcker Rule, possibly using disseminated information flows from the connected banks to facilitate their activities. At the same time, connected hedge funds significantly reduce their liquidity provision in less liquid stocks (negative γ_3 in columns (8) and (9)), likely responding to the overall deterioration in market liquidity and tighter funding flows revealed by our earlier results.

[Table 11 in here]

Examining at the effect of hedge fund characteristics on their liquidity provision (Table 12), it appears that historically, the majority of fund characteristics do not matter in terms of explaining the liquidity provision of hedge funds to less liquid stocks (η_0 is not statistically significant in columns (7)-(11)). The only exception is a low redemption notice period, which leads to lower liquidity provision in such stocks. There has been more variation with respect to liquidity provision in the more liquid segment of the equity market. Funds imposing a lockup, having a low notice period prior to redemption and poor past performance provide less liquidity, whereas young and small funds and those using leverage engage in more market-making activity in the more liquid component of the market.

Subsequent to the Volcker Rule (η_1), poorly performing funds decrease their liquidity provision for liquid stocks, but increase it for illiquid stocks, possibly in an attempt to enhance their returns. Young funds increase liquidity provision in both segments, but the effect is more pronounced in liquid stocks, whereas small funds decrease their liquidity provision in illiquid stocks. Poorly performing and young funds further augment their liquidity provision to the illiquid market segment if they are connected to LCFIs (corresponding η_3 is positive and significant). The fund characteristics of connected funds do not alter their liquidity provision to liquid stocks post Volcker Rule. The results we detail in Appendix B further show that a prime brokerage relationship does not alter the effect of the Volcker Rule on hedge fund liquidity provision.

[Table 12 in here]

In relation to fund strategy, non-directional and semi-directional funds generally demand liquidity trading liquid stocks (Table 13) as evidenced by the negative and highly significant coefficients γ_0 in columns (2) and (3), whereas directional funds seem to provide it. For illiquid stocks, all fund categories are historically liquidity providers. Following the Volcker Rule, all fund categories reduce their liquidity provision to illiquid stocks (negative and significant γ_1 in columns (4) to (6)), with Directional funds turning from liquidity providers to liquidity demanders. This effect is somewhat mitigated if these funds are connected to LCFIs. Non-direction funds are the only category that increases its liquidity provision after the Volcker Rule, but only in the more liquid stocks.

[Table 13 in here]

Tables 14 and 15 reveal that most investment styles (with the exception of Managed Futures) exhibit a significantly negative relation with Rlp^{Liquid}, and all fund styles exhibit a positive relation with $Rlp^{Illiquid}$, suggesting that hedge funds generally perform as liquidity re-distributors. As a class, they demand liquidity in the more liquid stock-market segment and provide it to a less liquid segment. The Volcker Rule leads to more variation in hedge fund liquidity provision to the liquid segment of the market. Fixed Income, Relative Value, Multi Strategy, and Other fund styles engage more intensively in market making activity in liquid stocks. The corresponding coefficients on $Rlp \cdot Volcker$ are significantly positive. For the illiquid stock segment, all styles reduce their liquidity provision, with the Event Driven funds connected to LCFIs exhibiting a stronger reduction. Overall, after implementation of the Volcker Rule, hedge funds withdraw from their role of liquidity re-distribution, which they are previously assuming.

[Tables 14 and 15 in here]

5 Robustness

5.1 The Implementation Period of the Volcker Rule

In our main analysis we concentrate on the effect of the Volcker Rule after it has become operative from April 1, 2014. However, it became a law as early as July 21, 2010 as part of the Dodd-Frank Act. In this section we test if hedge funds started to adjust their liquidity provision strategies after the information about the law has been released. We expect to observe a gradual adjustments during this period of fund flows, liquidity exposure and liquidity provision, but not to the full extent as after April 2014. We repeat the main analysis including an additional dummy variable *Dodd*, which equals one from July 2010 to March 2014, and zero otherwise.

The results reported in Tables 16, 17, and 18 generally confirm our intuition of gradual changes in the key variables of interest.

The levels of flow to hedge funds drop significantly after the Volcker Rule becomes a law as part of the Dodd-Frank Act in July 2010 (Table 16). The effect becomes much stronger after April 2014. For annual flows, for example, the corresponding coefficients are -0.127 and -0.258 both significant at the 1% level. Similar effect can be seen for the flow-performance sensitivity. In column (6), the flow-performance sensitivity of connected funds increases with β_3^{Dodd} being 0.024 significant at the 5% level, and it goes even higher after April 2014, with β_3 of 0.082 significant at the 1% level.

Interestingly, the announcement of the regulations does not have the immediate pronounced effect on hedge fund market liquidity exposure. No interactions with *Dodd*-dummy is statistically significant in Table 17, whereas the interactions $Volcker$-dummy remain statistically significant and qualitatively unchanged compared to the main results.

As for liquidity provision by hedge funds, we see the immediate effect after the announcement, with hedge funds turning into liquidity demanders for illiquid stocks and liquidity providers for more liquid stocks. For connected funds the effect is somewhat stronger after the Volcker Rule becomes operational in April 2014. For example, in column (9) of Table 18 the exposure to the returns from liquidity provision to illiquid stocks decreases after July 2010 with γ_3^{Dodd} being -33.356, signifiant at the 5% level. The decline in the exposure is even stronger after April 2014 with γ_3 being -42.384, also signifiant at the 5% level.

[Tables 16 and 17 and 18 in here]

5.2 Sub-sample of Hedge Funds Connected to US- and non-US LCFIs

In this section we repeat the analysis using only a sub-sample of hedge funds connected via prime brokerage or other types of connections to US based and non-US based LCFIs to check if the results are robust to exclusion of those funds that are not connected to any big institutions. Since non-US based LCFIs are not targeted by the Volcker Rule, one could expect to obtain qualitatively unchanged results.

At the same time, European based financial institutions also have been facing tighter regulations during this period. One of the key elements has been Basel III regulations, initiated between 2013 and 2015, which can have an impact banks' prime brokerage and investment activity. For example, Basel III requires banks to hold high quality liquid assets, assets that are sufficient to withstand a 30 day market stress event. Any investment in hedge fund would be considered extremely illiquid and could not contribute to the good liquidity ratios of banks. Furthermore, Basel III regulations attempt to reduce banks' reliance on short-term funding

for fear of liquidity mismatches through the regulatory "Net Stable Funding Ratio (NSFR)". As hedge fund cash deposits at prime brokerage arms of these banks is susceptible to"cash capital flight" in times of market volatility, regulators are demanding that banks hold more capital to safeguard against this risk. This is likely to incentivise a number of banks to sever their relationships with hedge funds, especially smaller or less profitable ones. Additionally on January 29, 2014, the European Commission proposed new rules to stop the biggest and most complex banks from engaging in the risky activity of proprietary trading. The proposal was based on the Liikanen report delivered in October 2012, and 29 European banks were affected by it. This proposal was, however, withdrawn in July 2018.

Thus, even though large European banks are not directly targeted by the Volcker Rule, during this period they also may be withdrawing form the hedge fund business, resulting in the effect similar to that of the Volcker Rule. Thus, even the results based on the sub-sample of hedge funds linked to US and non-UD LCFIs only are expected to be weaker that those using the complete sample of hedge funds.

Indeed, as reported in Tables 19, 20 and 21 the effect of the Volcker Rule and its interaction with the *Connect* dummy always go in the same direction as the ones based on the complete sample, but at times the significance of the interaction terms between $Volcker$ and $Connect$ dummies is weaker. For example, the results for hedge fund flows do not qualitatively change (Table 19). The exposure of hedge funds to market liquidity drops significantly after the Volcker Rule, similarly to the main results, but the amplifying effect of $LIQ \cdot Volcker \cdot Connect$ is no longer significant, although still negative (Table 20). Similarly, the results for relocation of liquidity provision from illiquid to liquid stocks are in line with the main results, but the negative amplifying effect of $Rlp \cdot Volcker \cdot Connect$ loses significance.

[Tables 19 and 20 and 21 in here]

6 Conclusion

The nature of the relationship between hedge funds and LCFIs is attracting increasing attention from both academics and policy-makers subsequent to the 2008 financial crisis, amid enhanced concerns about financial stability. In this paper, we examine the impact of the implementation of the Volcker Rule, a post-crisis banking regulation, on the hedge fund circle of liquidity. The Volcker Rule prohibits banks from proprietary trading and constrains their ability to invest in hedge funds. To the best of our knowledge, the indirect regulatory effects of the Volcker Rule on hedge funds are not previously explored in the literature. Our key findings relate to three components of the liquidity circle impacted by the Volcker rule: (1) a reduction of equity market liquidity due to a prohibition of proprietary trading by banks and shrinking of their market-making activities, (2) the increasing uncertainty surrounding funding

liquidity of hedge funds, arising from banks' retrenchment from hedge fund investment, and (3) the resulting decrease in hedge funds' willingness to take on liquidity risk and a shift in their market-making activities from illiquid to liquid stocks.

Specifically, we find that after the Rule the average bid-ask spread of common stocks increases, and the returns from supplying market liquidity become negative, suggesting a deterioration of stock market liquidity following the regulation's implementation. Hedge funds experience lower capital flows, and the flow-performance relationship becomes stronger after the Volcker Rule. The impact is more pronounced for funds that are likely to receive direct investments from US LCFIs. We proxy the likelihood of banks' direct investments into hedge funds by the existence of business connections between them, arising when a US-based LCFI serves as an administrator, auditor, custodian or advisor to a hedge fund. In contrast, the existence of a prime brokerage relationship with a US-based LCFI, often the subject of previous research, does not change the impact of the regulation.

Facing a deterioration in both market and funding liquidity, hedge funds appear to rebalance their portfolios towards more liquid holdings after the implementation of the Volcker Rule, reducing the exposure of their returns to market liquidity factors. This effect is especially pronounced for connected funds funds with poor past performance, which are less likely to retain investor capital. At the level of hedge fund style, the liquidity exposure reduction is associated with non-directional funds, in particular connected funds in the Equity Market Neutral and Relative Value categories. These strategies aim to exploit price differences between related financial instruments, thereby helping to reduce mispricing. The retreat of hedge funds from less liquid investments after the Volcker Rule is likely to further worsen market liquidity and negatively affect market efficiency.

We show that prior to the Volcker Rule, hedge funds play the role of liquidity re-distributors. They can be characterised as liquidity demanders when trading in more liquid equity market segments and liquidity suppliers in telation to their trading in the less liquid segments, thus contributing to balancing out the market. Subsequent to the Volcker Rule, hedge funds, especially those able to benefit from any information dissemination and associated expertise of LCFIs sourced through their contractual connections, appear to step into the market making role, one previously undertaken by the LCFIs, in the liquid stock segment. However, they retreat from market making for less liquid stocks. The liquidity re-distribution in the market is thereby disrupted, leading to a further dispersion in liquidity for individual stocks after the implementation of the Volcker Rule.

Viewed from a policy perspective, our findings contribute to an understanding of the far reaching effects of the Volcker Rule, beyond its direct aim of stimulating prudent investment from LCFIs. They provide a prescient warning of the possible unintended consequences of future financial market and banking regulations.

Reference

Agarwal, V. and Naik, N. Y. Multi-period performance persistence analysis of hedge funds. *Journal of financial and quantitative analysis*, 35(3):327–342, 2000.

Amihud, Y. Illiquidity and stock returns: cross-section and time-series effects. *Journal of financial markets*, 5(1):31–56, 2002.

Ang, A., Gorovyy, S., and Van Inwegen, G. B. Hedge fund leverage. *Journal of Financial Economics*, 102(1):102–126, 2011.

Aragon, G. O. and Strahan, P. E. Hedge funds as liquidity providers: Evidence from the lehman bankruptcy. *Journal of Financial Economics*, 103(3):570–587, 2012.

Artavanis, N. T., Eksi, A. A., and Kadlec, G. B. Mutual fund flows and downside risk. *Available at SSRN 3302876*, 2018.

Bao, J., O'Hara, M., and Zhou, X. A. The volcker rule and corporate bond market making in times of stress. *Journal of Financial Economics*, 130(1):95–113, 2018.

Ben-David, I., Franzoni, F., Landier, A., and Moussawi, R. Do hedge funds manipulate stock prices? *The Journal of Finance*, 68(6):2383–2434, 2013.

Billio, M., Getmansky, M., Lo, A. W., and Pelizzon, L. Econometric measures of connectedness and systemic risk in the finance and insurance sectors. *Journal of Financial Economics*, 104 (3):535–559, 2012.

Bollen, N. P. Mutual fund attributes and investor behavior. *Journal of Financial and Quantitative Analysis*, 42(3):683–708, 2007.

Boyson, N. M., Stahel, C. W., and Stulz, R. M. Hedge fund contagion and liquidity shocks. *The Journal of Finance*, 65(5):1789–1816, 2010.

Brandon, R. G. and Wang, S. Liquidity risk, return predictability, and hedge funds' performance: An empirical study. *Journal of Financial and Quantitative Analysis*, 48(1): 219–244, 2013.

Brunnermeier, M. K. and Pedersen, L. H. Market liquidity and funding liquidity. *The Review of Financial Studies*, 22(6):2201–2238, 2008.

Cao, C., Chen, Y., Liang, B., and Lo, A. W. Can hedge funds time market liquidity? *Journal of Financial Economics*, 109(2):493–516, 2013.

Cao, C., Liang, B., Lo, A. W., and Petrasek, L. Hedge fund holdings and stock market efficiency. *The Review of Asset Pricing Studies*, 8(1):77–116, 2017.

Chan, N., Getmansky, M., Haas, S. M., and Lo, A. W. Systemic risk and hedge funds. Technical report, National Bureau of Economic Research, 2005.

Chevalier, J. and Ellison, G. Risk taking by mutual funds as a response to incentives. *Journal of Political Economy*, 105(6):1167–1200, 1997.

Chow, J. T. and Surti, J. *Making banks safer: Can Volcker and Vickers do it?* Number 11-236. International Monetary Fund, 2011.

Chung, J.-W. and Kang, B. U. Prime broker-level comovement in hedge fund returns: information or contagion? *The Review of Financial Studies*, 29(12):3321–3353, 2016.

Chung, S., Keppo, J., and Yuan, X. The impact of volcker rule on bank profits and default probabilities. *Available at SSRN 2167773*, 2016.

Cumming, D., Dai, N., and Johan, S. Dodd-franking the hedge funds. *Journal of Banking & Finance*, 2017.

Dahlquist, M., Sokolovski, V., and Sverdrup, E. Hedge funds and financial intermediaries. *Available at SSRN 3396632*, 2019.

Dardanelli, G. T. Direct or indirect regulation of hedge funds: A european dilemma. *European Journal of Risk Regulation*, 2(4):463–480, 2011.

De Andrade Jr, F. Measures of downside risk and mutual fund flows. Technical report, Working Paper, 2009.

Ding, B., Getmansky, M., Liang, B., and Wermers, R. Investor flows and share restrictions in the hedge fund industry. *SSRN eLibrary*, 2008.

Duffie, D. Market making under the proposed volcker rule. *Rock Center for Corporate Governance at Stanford University Working Paper*, (106), 2012.

Elayan, F. A., Aktas, R., Brown, K., and Pacharn, P. The impact of the volcker rule on targeted banks, systemic risk, liquidity, and financial reporting quality. *Journal of Economics and Business*, 96:69–89, 2018.

Franzoni, F. and Giannetti, M. Costs and benefits of financial conglomerate affiliation: Evidence from hedge funds. *Journal of Financial Economics*, 2019.

Franzoni, F. and Plazzi, A. Do hedge funds provide liquidity? evidence from their trades. *Unpublished working paper. University of Lugano and Swiss Finance Institute*, 2013.

Ilerisoy, M., Sa-Aadu, J., and Tiwari, A. Funding liquidity risk and hedge fund performance. In *30th Australasian Finance and Banking Conference*, 2017.

Jiao, Y. Hedge funds and equity prices. *Review of Finance*, 17(3):1141–1177, 2012.

Jylhä, P., Rinne, K., and Suominen, M. Do hedge funds supply or demand liquidity? *Review of Finance*, 18(4):1259–1298, 2014.

Keppo, J. and Korte, J. Risk targeting and policy illusions: evidence from the announcement of the volcker rule. *Management Science*, 64(1):215–234, 2016.

Khandani, A. E. and Lo, A. W. What happened to the quants in august 2007? evidence from factors and transactions data. *Journal of Financial Markets*, 14(1):1–46, 2011.

King, M. R. and Maier, P. Hedge funds and financial stability: Regulating prime brokers will mitigate systemic risks. *Journal of Financial Stability*, 5(3):283–297, 2009.

Klaus, B. and Rzepkowski, B. Hedge funds and prime brokers: The role of funding risk. *EFA 2009 Bergen Meetings Paper*, 2009.

Kolokolova, O. and Mattes, A. A time to scatter stones, and a time to gather them: the annual cycle in hedge fund risk taking. *Financial Review*, 53(4):669–704, 2018.

Kolokolova, O., Lin, M.-T., and Poon, S.-H. Too big to ignore? hedge fund flows and bond yields. *Journal of Banking & Finance*, 2017.

Kruttli, M., Monin, P., and Watugala, S. Hedge fund credit networks, collateral, and prime broker exposures. *Available at SSRN 3140900*, 2018.

Kumar, N., Mullally, K., Ray, S., and Tang, Y. Prime (information) brokerage. *Available at SSRN 2996148*, 2018.

McGuire, P., Remolona, E. M., and Tsatsaronis, K. Time varying exposures and leverage in hedge funds. *BIS Quarterly Review, March*, 2005.

Mügge, D. *Europe and the governance of global finance*. Oxford University Press, USA, 2014.

Nabilou, H. and Pacces, A. M. The hedge fund regulation dilemma: Direct vs. indirect regulation. *Wm. & Mary Bus. L. Rev.*, 6:183, 2015.

Nagel, S. Evaporating liquidity. *The Review of Financial Studies*, 25(7):2005–2039, 2012.

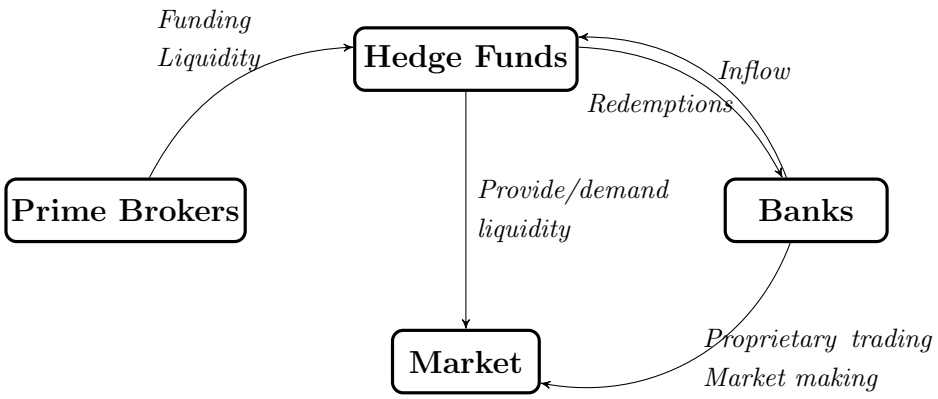
Pástor, L. and Stambaugh, R. F. Liquidity risk and expected stock returns. *Journal of Political Economy*, 111(3):642–685, 2003.

Puckett, A. and Yan, X. The interim trading skills of institutional investors. *The Journal of Finance*, 66(2):601–633, 2011.

Sadka, R. Liquidity risk and the cross-section of hedge-fund returns. *Journal of Financial Economics*, 98(1):54–71, 2010.

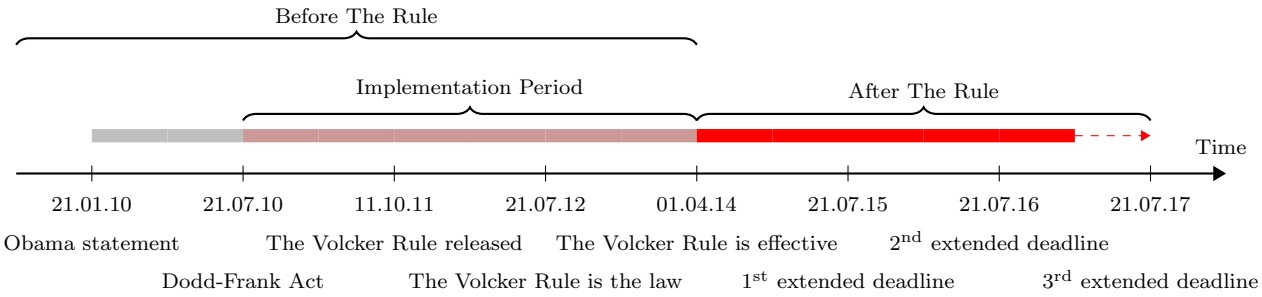
Schäfer, A., Schnabel, I., and Weder di Mauro, B. Financial sector reform after the subprime crisis: Has anything happened? *Review of Finance*, 20(1):77–125, 2015.

Teo, M. The liquidity risk of liquid hedge funds. *Journal of Financial Economics*, 100(1):24–44, 2011.



The figure depicts the direction of liquidity flows constituting the 'circle of liquidity' of hedge funds.

Figure 1: The hedge fund 'circle of liquidity'.



The figure depicts the timeline of the implementation of the Volcker Rule.

Figure 2: The timeline of the Volcker Rule.

Tables

Table 1: Classification of hedge fund strategies

This table reports the sample classification of hedge funds by investment strategy and the number of funds in each class. Funds of Funds are excluded from the sample.

Category	Strategy as labeled in the database	N of funds
Directional Funds		
Emerging Markets	'Emerging Markets'	317
Global Macro	'Global Macro', 'Macro'	567
Managed Futures	'CTA/Managed Futures','Managed Futures'	1,008
Non-Directional Funds		
Equity Market Neutral	'Equity Market Neutral'	254
Fixed Income	'Convertible Arbitrage', 'Fixed Income Arbitrage', 'Distressed Debt'	852
Relative Value	'Relative Value', 'Arbitrage', 'Value'	274
Semi-Directional Funds		
Event Driven	'Event Driven'	459
Long/Short Equities	'Long Short Equity Hedge', 'Long Short Equities', 'Dedicated Short Bias'	2,910
Multi-Strategy	'Multi-Strategy', 'Dual Approach'	1,364
Others		
Others	'Others', 'Bottom-Up', 'Top-Down', 'Diversified Debt', 'Undefined'	681
Total		8,686

Table 2: Summary Statistics for Hedge Fund Returns

This table reports descriptive statistics of hedge fund monthly returns in percent from January 1994 to December 2015. Panel A reports the statistics for the full sample and Panel B reports the statistics by investment category. The figures within a category are equally weighted averages of the statistics across the funds in the category. The sample includes funds in the Lipper TASS and Eurekahedge databases with at least 36 return observations which report returns in U.S. dollars.

Category	Mean	Median	SD	Skewness	Kurtosis	Min.	Max.	N
Panel A: Full Sample								
All Funds	0.563	0.557	3.971	-0.235	6.643	-10.730	13.628	8686
Panel B: By Hedge Fund Investment Style								
Directional Funds								
Emerging Markets	0.452	0.637	6.063	-0.379	7.802	-20.094	19.25	317
Global Macro	0.465	0.418	3.365	0.064	5.988	-8.782	10.482	567
Managed Futures	0.473	0.345	4.82	0.134	5.533	-12.626	15.098	1008
Non-Directional Funds								
Equity Market Neutral	0.739	0.455	5.682	-0.471	9.273	-9.932	33.974	254
Fixed Income	0.385	0.512	2.071	-0.674	8.555	-7.498	6.058	852
Relative Value	0.487	0.514	2.908	-0.279	5.875	-8.979	8.703	274
Semi-Directional Funds								
Event Driven	0.600	0.658	3.000	-0.518	6.983	-9.547	9.207	459
Long/Short Equities	0.599	0.628	4.109	-0.089	5.530	-11.546	12.810	2910
Multi Strategy	0.740	0.606	4.126	-0.376	7.765	-8.141	18.205	1364
Others								
Others	0.491	0.592	4.173	-0.453	7.506	-12.731	12.625	681

Table 3: Summary Statistics of Hedge Funds' Flows

This table reports descriptive statistics of hedge fund monthly funding flows from January 1994 to December 2015. Panel A reports the statistics for the full sample and Panel B reports the statistics by category. The figures within a category are equally weighted averages of the statistics across the funds in the category. The sample includes funds in the Lipper TASS and Eurekahedge databases with at least 36 return observations which report returns in U.S. dollars.

Category	Mean	Median	SD	Skewness	Kurtosis	Min.	Max.	N
Panel A: Full Sample								
All Funds	0.448	0.233	11.837	-0.139	6.085	-27.046	27.678	8686
Panel B: By Hedge Fund Investment Style								
Directional Funds								
Emerging Markets	-0.066	0.105	5.167	-0.472	7.584	-13.834	11.652	317
Global Macro	-2.648	-1.085	14.306	-0.366	6.408	-41.385	26.003	567
Managed Futures	0.374	0.027	5.575	-0.091	6.037	-12.789	14.292	1008
Non-Directional Funds								
Equity Market Neutral	6.643	10.165	21.017	-0.299	6.478	-34.050	45.559	254
Fixed Income	0.453	0.119	16.268	-0.060	5.473	-33.958	36.482	852
Relative Value	0.138	0.045	9.768	0.102	5.137	-23.944	23.570	274
Semi-Directional Funds								
Event Driven	3.305	1.020	13.263	-0.091	6.071	-25.351	38.917	459
Long/Short Equities	-1.054	-1.044	12.553	-0.052	5.781	-32.231	26.114	2910
Multi Strategy	2.745	1.683	12.711	-0.333	7.084	-24.366	36.274	1364
Others								
Others	0.967	0.386	7.882	-0.048	5.576	-16.314	20.616	681

Table 4: Summary Statistics of Hedge Funds' Characteristics

This table reports the descriptive statistics of the hedge funds characteristics including: assets under management (AuM, in million USD), fund age (in months), use of leverage (Leverage), use of high-water mark (HWM), management fee ($MgtFee$ in percent), incentive fee ($IncFee$ in percent), lock-up period (in months), total redemption period, which is the sum of redemption and advance notice periods (in months), and subscription period (in month).

	Mean	Median	SD	Skewness	Kurtosis	Min.	Max.	N
Panel A: Full Sample								
AuM($M)	272.393	247.231	137.700	0.340	3.072	90.237	562.214	8686
Age(Months)	33.334	25.360	30.157	0.821	3.617	0.000	89.614	8686
Leverage	0.524	1.000	0.500	-0.095	1.009	0.000	1.000	8686
HWM	0.684	1.000	0.465	-0.792	1.628	0.000	1.000	8686
MgtFee(%)	1.464	1.500	0.634	2.339	36.109	0.000	15.000	8686
IncFee(%)	16.302	20.000	7.321	-1.024	4.316	0.000	50.000	8686
Lockup(Months)	2.863	0.000	6.550	5.264	81.380	0.000	180.000	8686
Redemption(Months)	3.387	2.167	2.944	2.777	16.013	0.033	37.000	8686
Subscription(Months)	1.100	1.000	0.816	6.937	82.044	0.033	12.000	8686
Prime	0.319	0.000	0.466	0.779	1.607	0.000	1.000	8686
Connect	0.304	0.000	0.460	0.851	1.725	0.000	1.000	8686
Prime·Connect	0.195	0.000	0.396	1.542	3.378	0.000	1.000	8686
Prime (non-US)	0.156	0.000	0.363	1.900	4.609	0.000	1.000	8686
Connect (non-US)	0.217	0.000	0.412	1.375	2.890	0.000	1.000	8686
Prime·Connect (non-US)	0.082	0.000	0.274	3.056	10.340	0.000	1.000	8686
Panel B: Connected Funds								
AuM($M)	388.927	352.898	190.396	0.355	3.047	146.870	798.063	2642
Age(Months)	31.941	23.510	30.632	0.906	3.481	0.884	89.508	2642
Leverage	0.512	1.000	0.500	-0.049	1.002	0.000	1.000	2642
HWM	0.711	1.000	0.454	-0.928	1.862	0.000	1.000	2642
MgtFee(%)	1.457	1.500	0.567	0.915	10.594	0.000	6.000	2642
IncFee(%)	16.414	20.000	7.247	-1.047	4.685	0.000	50.000	2642
Lockup(Months)	2.818	0.000	5.969	2.786	14.387	0.000	60.000	2642
Redemption(Months)	3.430	2.167	3.012	2.873	17.611	0.033	37.000	2642
Subscription(Months)	1.116	1.000	0.905	7.031	77.845	0.033	12.000	2642
Panel C: Unconnected Funds								
AuM($M)	221.339	200.939	114.614	0.334	3.084	65.427	458.889	6044
Age(Months)	33.944	26.169	29.950	0.784	3.677	1.793	89.660	6044
Leverage	0.529	1.000	0.499	-0.115	1.013	0.000	1.000	6044
HWM	0.673	1.000	0.469	-0.736	1.541	0.000	1.000	6044
MgtFee(%)	1.468	1.500	0.661	2.706	41.316	0.000	15.000	6044
IncFee(%)	16.254	20.000	7.352	-1.013	4.166	0.000	50.000	6044
Lockup(Months)	2.883	0.000	6.788	5.966	97.573	0.000	180.000	6044
Redemption(Months)	3.368	2.167	2.915	2.728	15.184	0.033	36.000	6044
Subscription(Months)	1.093	1.000	0.774	6.764	81.993	0.033	12.000	6044

Table 5: Equity Market Liquidity around the Volcker Rule

This table reports the summary statistics of Amihud (2002) illiquidity measure (*Amihud*), bid-ask spread (*BAS*), Pástor and Stambaugh (2003) monthly innovations in aggregate market liquidity (*LIQ*), and Jylhä et al. (2014) returns from providing liquidity (*Rlp*) before and after the Volcker Rule. The pre-Volcker period is from July 2012 to March 2014 and the post-Volcker period is from April 2014 to December 2015. The tests statistics are reported for the t-test in mean differences and the Kolmogorov-Smirnov test for the difference in distributions. *, **, and *** denote significance at the 10%, 5%, and 1% levels respectively.

Category	Mean	Median	SD	Skewness	Kurtosis	Min.	Max.	t-test	ks-test	cm-test
Panel A: Amihud										
Pre-Volcker	0.0023	0.0006	0.0071	41.8241	3702.8000	0.0000	0.7049	-4.5193***	0.0291***	2.2660***
Post-Volcker	0.0030	0.0005	0.0257	92.9446	1017.0000	0.0000	3.1904			
Panel B: Bid-ask spread (BAS)										
Pre-Volcker	0.0258	0.0221	0.0163	7.6786	172.2771	0.0000	0.6696	-14.492***	0.0493***	17.5907***
Post-Volcker	0.0280	0.0231	0.0197	11.1441	481.4997	0.0003	1.2055			
Panel C: LIQ										
Pre-Volcker	0.0017	0.0190	0.0401	0.2848	2.9713	-0.0596	0.0998	0.3387	0.1905	0.0381
Post-Volcker	0.0133	0.0109	0.0393	-0.1249	2.7186	-0.0771	0.0795			
Panel D: TradeLiq										
Pre-Volcker	-0.0050	-0.0086	0.0166	0.4316	2.3391	-0.0325	0.0299	-1.0091	0.3333	0.2447
Post-Volcker	0.0016	0.0029	0.0249	-0.8152	3.7529	-0.0616	0.0397			
Panel E: Rlp										
Pre-Volcker	0.0480	0.0534	0.1034	-0.6261	3.5608	-0.2224	0.2308	2.4917**	0.4762**	0.6925**
Post-Volcker	-0.0545	-0.0305	0.1575	-0.4599	3.4428	-0.4034	0.2681			

Table 6: The Volcker Rule and Hedge Funds' Flow-Performance Relationship

This table reports the estimation results for the impact of the Volcker Rule on hedge funds' flow-performance relationship. $Flow_t$ is the flow for fund i in month t and $\overline{Flow^i}_{t:t+11}$ is the average monthly flow for fund i from month t to $t+11$. *Ret* is the average past year return, $Volcker$ is a dummy variable that equals 1 after April 2014, *Prime* is a dummy variable that equals 1 if a US-based LCFI is a prime broker of a hedge fund and *Connect* is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
		$Flow_t$			$\overline{Flow}_{t:t+11}$	
Ret (β_0)	0.004***	0.004***	0.004***	0.052***	0.053***	0.052***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)
Volcker (γ_0)	-0.004***	-0.003***	-0.003***	-0.181***	-0.153***	-0.161***
	(0.000)	(0.000)	(0.000)	(0.009)	(0.009)	(0.010)
Ret·Volcker (β_1)	0.000	0.000	-0.000	0.060***	0.045***	0.046***
	(0.000)	(0.000)	(0.000)	(0.007)	(0.007)	(0.007)
Prime (γ_1)	-0.000		0.000	0.043		0.077*
	(0.001)		(0.001)	(0.044)		(0.045)
Volcker·Prime (γ_2)	-0.001		-0.001	0.079***		0.063**
	(0.001)		(0.001)	(0.026)		(0.026)
Ret·Prime (β_2)	0.002***		0.002***	0.002		0.002
	(0.000)		(0.000)	(0.004)		(0.004)
Ret·Volcker·Prime (β_3)	0.002***		0.002***	-0.024		-0.012
	(0.001)		(0.001)	(0.019)		(0.020)
Connect (γ_1)		0.005***	0.005***		0.342***	0.350***
		(0.001)	(0.001)		(0.047)	(0.047)
Volcker·Connect (γ_2)		-0.006***	-0.006***		-0.131***	-0.125***
		(0.001)	(0.001)		(0.023)	(0.023)
Ret·Connect (β_2)		-0.000*	-0.000		-0.000	-0.000
		(0.000)	(0.000)		(0.004)	(0.004)
Ret·Volcker·Connect (β_3)		0.001	0.001		0.081***	0.080***
		(0.001)	(0.001)		(0.017)	(0.017)
STD	-0.001***	-0.001***	-0.001***	-0.018***	-0.018***	-0.018***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
lnAUM	-0.001***	-0.001***	-0.001***	-0.367***	-0.368***	-0.368***
	(0.000)	(0.000)	(0.000)	(0.003)	(0.003)	(0.003)
HWM	-0.001***	-0.001***	-0.001***	0.123***	0.108***	0.106***
	(0.000)	(0.000)	(0.000)	(0.037)	(0.037)	(0.037)
MgtFee	0.001***	0.001**	0.001**	0.002	-0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.025)	(0.025)	(0.025)
IncFee	-0.000	-0.000	-0.000	0.004*	0.004*	0.004*
	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)
Age	0.000***	0.000***	0.000***	-0.004***	-0.004***	-0.004***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Redemption	0.000	0.000	0.000	-0.000*	-0.000*	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-0.000	-0.000	-0.000	-0.057*	-0.050	-0.049
	(0.000)	(0.000)	(0.000)	(0.032)	(0.032)	(0.032)
LockUp	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)
StyleEffect	0.000***	0.000***	0.000***	0.088***	0.088***	0.088***
	(0.000)	(0.000)	(0.000)	(0.007)	(0.007)	(0.007)
Constant	0.005***	0.005***	0.004***	1.400***	1.377***	1.368***
	(0.001)	(0.001)	(0.001)	(0.062)	(0.062)	(0.062)
R-squared	0.0035	0.0035	0.0035	0.0045	0.0045	0.0045
Number of HFs	6,788	6,788	6,788	6,183	6,183	6,183

Table 7: The Volcker Rule and hedge funds' market liquidity exposure

This table reports the estimation results for the impact of the Volcker Rule on hedge funds' exposure to market liquidity risk. *LIQ* represents the Pástor and Stambaugh (2003) market liquidity factor, *Volcker* is a dummy variable that equals 1 after April 2014, *Prime* is a dummy variable that equals 1 if a US-based LCFI is a prime broker of a hedge fund, and *Connect* is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Prime	(2) Connect	(3) Both
LIQ (γ_0)	4.848***	4.738***	4.374***
	(1.522)	(1.450)	(1.674)
LIQ·Volcker (γ_1)	-6.342***	-6.188***	-5.898***
	(1.503)	(1.441)	(1.651)
LIQ·Prime (γ_2)	1.915		2.241
	(1.387)		(1.488)
LIQ·Volcker·Prime (γ_3)	-1.396		-1.701
	(1.582)		(1.667)
LIQ·Connect (γ_2)		3.833***	4.077***
		(1.353)	(1.490)
LIQ·Volcker·Connect (γ_3)		-3.634**	-3.823**
		(1.544)	(1.658)
MKT	-0.823	-0.818	-0.822
	(1.766)	(1.764)	(1.766)
SMB	-1.049**	-1.054**	-1.047**
	(0.517)	(0.520)	(0.517)
TERM	-0.739**	-0.737**	-0.737**
	(0.344)	(0.344)	(0.344)
CREDIT	-4.185***	-4.182***	-4.183***
	(0.697)	(0.696)	(0.696)
PTFSBD	-1.702***	-1.700***	-1.702***
	(0.261)	(0.262)	(0.261)
PTFSFX	1.459***	1.461***	1.460***
	(0.135)	(0.136)	(0.135)
PTFSCOM	-0.543***	-0.544***	-0.544***
	(0.121)	(0.120)	(0.120)
Constant	0.637***	0.636***	0.636***
	(0.022)	(0.021)	(0.021)
R-squared	0.003	0.003	0.003
Number of HFs	8,686	8,686	8,686
Fund fixed effect	Yes	Yes	Yes

Table 8: The Volcker Rule and hedge funds' market liquidity exposure by fund characteristics

This table reports the impact of the Volcker Rule on hedge funds' exposure to market liquidity risk after controlling for fund characteristics. *LIQ* represents the Pástor and Stambaugh (2003) market liquidity factor, *Volcker* is a dummy variable that equals 1 after April 2014, and *Connect* is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. *X* indicates hedge fund characteristics: *Weak* equals 1 for funds with returns below the median in each hedge fund category; *Lever* equals 1 if a fund uses leverage; *Young* equals 1 if a fund's age is below the median across all live funds; *Small* equals 1 if a fund's assets under management are below the median; *Lock* equals 1 for funds with lock-up periods; *LowRed* equals 1 for funds with a total redemption period. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
$X =$	Weak	Lever	Young	Small	Lock	LowRed
LIQ (γ_0)	6.419***	6.448***	4.809***	6.313***	4.557**	5.195***
	(0.433)	(0.487)	(1.667)	(0.426)	(1.868)	(0.301)
LIQ·Volcker (γ_1)	-12.253***	-7.779***	-6.153***	-7.146***	-6.487***	-6.639***
	(0.727)	(0.760)	(1.701)	(0.715)	(1.762)	(0.490)
LIQ·Connect (γ_2)	2.262***	1.263	4.304***	2.240***	4.065**	2.200**
	(0.727)	(0.831)	(1.664)	(0.671)	(1.737)	(0.878)
LIQ·Volcker·Connect (γ_3)	0.336	-3.306**	-5.873***	-2.105**	-3.884**	-2.671**
	(1.343)	(1.540)	(2.158)	(1.062)	(1.964)	(1.340)
X (δ)	0.009	0.115*	0.351***	0.511**	-0.047	-0.135**
	(0.071)	(0.061)	(0.053)	(0.224)	(0.065)	(0.056)
LIQ·X (η_0)	-4.148	-3.251	-0.175	-5.038	0.263	-1.110
	(3.201)	(2.291)	(1.360)	(3.966)	(1.887)	(2.977)
LIQ·Volcker·X (η_1)	13.424***	2.779	0.629	3.195	1.159	0.743
	(2.774)	(2.101)	(1.544)	(3.200)	(1.787)	(3.002)
LIQ·Connect·X (η_2)	3.869	4.677*	-1.907	5.071	-1.153	3.759
	(3.305)	(2.590)	(1.884)	(4.154)	(2.292)	(3.142)
LIQ·Volcker·Connect·X (η_3)	-8.977**	-1.114	4.848*	-5.061	-1.317	-1.307
	(3.627)	(3.033)	(2.509)	(4.496)	(2.984)	(3.480)
Constant	0.633***	0.537***	0.533***	0.468***	0.609***	0.691***
	(0.012)	(0.024)	(0.033)	(0.053)	(0.061)	(0.037)
R-squared	0.003	0.003	0.003	0.003	0.003	0.003
Number of HFs	8,655	8,655	8,655	8,655	8,655	8,655
Fund fixed effect	Yes	No	Yes	Yes	No	Yes
Fung and Hsieh 7 factors	Yes	Yes	Yes	Yes	Yes	Yes

Table 9: The Volcker Rule and hedge funds' market liquidity exposure by investment style category

This table compares the impact of the Volcker Rule on directional, non-directional and semi-directional funds' exposure to market liquidity risk. *LIQ* represents the Pástor and Stambaugh (2003) market liquidity factor, *Volcker* is a dummy variable that equals 1 after April 2014, and *Connect* is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Directional	(2) Non-directional	(3) Semi-directional
LIQ (γ_0)	6.047***	3.989***	4.025
	(0.409)	(0.804)	(2.557)
LIQ·Volcker (γ_1)	-14.706***	-4.107**	-4.232*
	(1.118)	(1.685)	(2.471)
LIQ·Connect (γ_2)	1.033	4.480*	3.232
	(1.765)	(2.394)	(2.228)
LIQ·Volcker·Connect (γ_3)	1.196	-4.629*	-4.011
	(3.232)	(2.652)	(2.470)
MKT	1.867***	1.066**	-2.262
	(0.359)	(0.428)	(3.167)
SMB	-0.101	-0.079	-1.323
	(0.631)	(0.933)	(0.860)
TERM	-1.354***	0.414	-0.702
	(0.105)	(1.474)	(0.487)
CREDIT	-2.531***	-0.750	-5.138***
	(0.198)	(2.881)	(1.029)
PTFSBD	-0.707***	-2.289***	-1.709***
	(0.175)	(0.541)	(0.452)
PTFSFX	2.457***	0.866	1.202***
	(0.132)	(0.638)	(0.179)
PTFSCOM	1.298***	-0.777**	-0.912***
	(0.170)	(0.315)	(0.185)
Constant	0.601***	0.497***	0.698***
	(0.005)	(0.007)	(0.037)
R-squared	0.016	0.001	0.003
Number of HFs	1,922	1,380	4,703
Fund fixed effect	Yes	Yes	Yes

Table 10: The Volcker Rule and hedge funds' market liquidity exposure by investment strategy

This table reports the impact of the Volcker Rule on hedge funds' exposure to market liquidity risk by different investment strategies. *LIQ* represents the Pástor and Stambaugh (2003) market liquidity factor, *Volcker* is a dummy variable that equals 1 after April 2014, and *Connect* is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Long/Short Equities	(2) Emerging Markets	(3) Global Macro	(4) Managed Futures	(5) Fixed Income	(6) Equity Market Neutral	(7) Relative Value	(8) Event Driven	(9) Multi Strategy	(10) Others
LIQ (γ_0)	7.373***	13.713***	3.980***	4.540***	2.661***	6.242**	5.683***	5.219***	-6.748	9.212***
	(0.248)	(1.077)	(0.677)	(0.441)	(0.433)	(2.939)	(1.050)	(0.472)	(10.990)	(0.832)
LIQ·Volcker (γ_1)	-6.390***	-14.696***	-5.608***	-19.392***	-2.091***	-11.256	-3.597**	-5.033***	4.120	-3.650***
	(0.650)	(3.191)	(1.405)	(1.636)	(0.632)	(7.799)	(1.470)	(1.698)	(10.532)	(1.264)
LIQ·Connect (γ_2)	0.010	-1.738	-1.324	4.420**	0.436	9.334	8.688**	-0.186	13.445	6.543**
	(0.854)	(4.448)	(1.848)	(2.122)	(1.084)	(7.737)	(3.890)	(1.451)	(8.955)	(2.614)
LIQ·Volcker·Connect (γ_3)	0.992	-13.700	5.606**	-5.395	0.833	-16.240**	-16.076**	-2.415	-17.877**	-9.583***
	(1.655)	(12.832)	(2.528)	(5.051)	(1.445)	(7.924)	(7.123)	(3.357)	(8.957)	(3.332)
MKT	0.347	-1.000	0.432	2.989***	1.251***	2.557**	-0.316	5.086***	-10.236	-1.237*
	(0.249)	(0.995)	(0.583)	(0.497)	(0.443)	(1.229)	(0.714)	(0.507)	(10.951)	(0.743)
SMB	-0.425	10.365***	-1.114	-3.222***	1.429***	-2.645	-1.654	1.027*	-4.063	-3.693***
	(0.431)	(1.792)	(0.863)	(0.728)	(0.396)	(3.736)	(1.203)	(0.595)	(2.557)	(0.991)
TERM	-0.032	-1.037***	-1.047***	-1.587***	-1.455***	6.335	-0.700***	-0.588***	-2.331	-1.032***
	(0.058)	(0.231)	(0.186)	(0.144)	(0.153)	(6.488)	(0.211)	(0.104)	(1.744)	(0.136)
CREDIT	-4.493***	-8.168***	-1.765***	-0.932***	-3.738***	10.735	-5.886***	-4.497***	-6.648*	-7.546***
	(0.134)	(0.523)	(0.262)	(0.218)	(0.229)	(12.024)	(0.589)	(0.299)	(3.581)	(0.365)
PTFSBD	-2.384***	-5.217***	-1.290***	0.731***	-1.542***	-3.246*	-2.515***	-2.516***	0.077	-3.506***
	(0.090)	(0.379)	(0.242)	(0.243)	(0.122)	(1.765)	(0.320)	(0.169)	(1.611)	(0.242)
PTFSFX	1.237***	1.421***	2.134***	2.979***	0.144*	2.956	0.731***	0.513***	1.157**	1.783***
	(0.056)	(0.248)	(0.223)	(0.195)	(0.076)	(2.892)	(0.193)	(0.094)	(0.507)	(0.144)
PTFSCOM	-1.161***	-2.067***	0.153	2.981***	-0.995***	1.128	-2.164***	-1.410***	-0.158	-2.681***
	(0.083)	(0.369)	(0.182)	(0.244)	(0.105)	(1.409)	(0.267)	(0.148)	(0.562)	(0.178)
Constant	0.650***	0.611***	0.553***	0.642***	0.399***	0.768***	0.523***	0.577***	0.867***	0.533***
	(0.003)	(0.011)	(0.009)	(0.007)	(0.006)	(0.017)	(0.010)	(0.005)	(0.154)	(0.009)
R-squared	0.066	0.109	0.013	0.027	0.070	0.003	0.129	0.114	0.001	0.121
Number of HFs	2,910	317	567	1,008	852	254	274	459	1,364	681

Table 11: The Volcker Rule and hedge funds' liquidity provision

This table reports the estimation results for the impact of the Volcker Rule on hedge funds' liquidity provision. *Rlp* represents the returns from providing liquidity calculated based on the method proposed by Jylhä et al. (2014), Rlp^{Liquid} and $Rlp^{Illiquid}$ are calculated using sub-samples of stocks with the Amihud measure below and above the median respectively, $Volcker$ is a dummy variable that equals 1 after April 2014, *Prime* is a dummy variable that equals 1 if a US-based LCFI is a prime broker of a hedge fund, and *Connect* is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		Rlp			Rlp^{Liquid}			$Rlp^{Illiquid}$	
Rlp (γ_0)	-1.318***	-1.246***	-1.257***	-3.226*	-0.641	-0.299	83.343***	82.386***	83.590***
	(0.164)	(0.150)	(0.203)	(1.867)	(1.817)	(1.993)	(1.956)	(1.938)	(2.055)
Rlp·Volcker (γ_1)	2.327***	2.199***	2.159***	8.484	0.412	5.119	-67.677***	-63.998***	-63.909***
	(0.164)	(0.153)	(0.203)	(6.213)	(6.331)	(6.828)	(4.308)	(4.366)	(4.654)
Rlp·Prime (γ_2)	0.107		0.066	-0.099		-2.141	-7.223		-7.398*
	(0.322)		(0.348)	(5.025)		(5.037)	(4.455)		(4.472)
Rlp·Volcker·Prime (γ_3)	0.197		0.318	-38.211**		-35.845**	0.393		-2.388
	(0.412)		(0.435)	(17.035)		(17.192)	(11.233)		(11.295)
Rlp·Connect (γ_2)		-0.522	-0.514		-23.991***	-24.225***		-1.264	-2.089
		(0.347)	(0.379)		(5.491)	(5.510)		(4.815)	(4.833)
Rlp·Volcker·Connect (γ_3)		1.128***	1.159**		30.453**	26.901*		-22.336**	-22.475**
		(0.429)	(0.458)		(15.363)	(15.500)		(10.100)	(10.155)
MKT	-1.030	-1.031	-1.030	0.243**	0.249**	0.249**	0.613***	0.612***	0.613***
	(1.638)	(1.639)	(1.638)	(0.123)	(0.123)	(0.123)	(0.121)	(0.121)	(0.121)
SMB	1.235	1.238	1.238	0.385**	0.380**	0.380**	1.448***	1.450***	1.449***
	(0.776)	(0.778)	(0.777)	(0.187)	(0.187)	(0.187)	(0.188)	(0.188)	(0.188)
TERM	-0.635**	-0.634**	-0.634**	-0.486***	-0.485***	-0.485***	-0.412***	-0.412***	-0.413***
	(0.318)	(0.319)	(0.319)	(0.032)	(0.032)	(0.032)	(0.031)	(0.031)	(0.031)
CREDIT	-4.208***	-4.207***	-4.207***	-3.617***	-3.616***	-3.616***	-3.919***	-3.919***	-3.919***
	(0.608)	(0.608)	(0.608)	(0.061)	(0.061)	(0.061)	(0.064)	(0.064)	(0.064)
PTFSBD	-1.630***	-1.631***	-1.631***	-1.680***	-1.680***	-1.680***	-1.581***	-1.582***	-1.581***
	(0.227)	(0.229)	(0.227)	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)
PTFSFX	1.370***	1.369***	1.369***	1.157***	1.158***	1.158***	1.295***	1.295***	1.295***
	(0.151)	(0.151)	(0.151)	(0.035)	(0.035)	(0.035)	(0.036)	(0.036)	(0.036)
PTFSCOM	-0.633***	-0.631***	-0.631***	-0.645***	-0.645***	-0.645***	-0.624***	-0.624***	-0.624***
	(0.139)	(0.138)	(0.139)	(0.045)	(0.045)	(0.045)	(0.046)	(0.046)	(0.046)
Constant	0.680***	0.680***	0.680***	0.587***	0.587***	0.587***	0.619***	0.619***	0.619***
	(0.021)	(0.021)	(0.021)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
R-squared	0.003	0.003	0.003	0.045	0.045	0.045	0.049	0.049	0.049
Number of HFs	8,686	8,686	8,686	8,686	8,686	8,686	8,686	8,686	8,686
Fund fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 12: The Volcker Rule and hedge funds' liquidity provision by fund characteristics

This table reports the impact of the Volcker Rule on hedge funds' liquidity provision after controlling for fund characteristics. Rlp^{Liquid} and $Rlp^{Illiquid}$ represent the returns from providing liquidity calculated based on the method proposed by Jylhä et al. (2014) for stocks with the Amihud illiquidity measure below and above the median respectively, $Volcker$ is a dummy variable that equals 1 after April 2014 and $Connect$ is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. X indicates hedge fund characteristics: $Weak$ equals 1 for funds with returns below the median in each hedge fund category; $Lever$ equals 1 if a fund uses leverage; $Young$ equals 1 if a fund's age is below the median across all live funds; $Small$ equals 1 if a fund's assets under management are below the median; $Lock$ equals 1 for funds with lock-up periods; $LowRed$ equals 1 for funds with a total redemption period. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$Rlp =$			Rlp^{Liquid}						$Rlp^{Illiquid}$			
$X =$	Weak	Lever	Young	Small	Lock	LowRed	Weak	Lever	Young	Small	Lock	LowRed
Rlp (γ_0)	2.420	-7.031***	-2.164	-5.927***	3.095	6.171**	84.028***	80.896***	83.767***	81.889***	84.684***	85.763***
	(2.185)	(2.652)	(2.228)	(2.163)	(2.142)	(2.517)	(2.344)	(2.543)	(2.083)	(2.174)	(2.133)	(2.501)
Rlp·Volcker (γ_1)	55.938***	17.666**	-10.240	-6.622	-5.058	-10.700	-80.098***	-59.893***	-66.877***	-55.081***	-65.015***	-66.441***
	(9.122)	(8.680)	(9.318)	(7.658)	(7.145)	(7.487)	(5.495)	(5.851)	(6.187)	(5.061)	(4.960)	(5.095)
Rlp·Connect (γ_2)	-16.146**	-15.996**	-29.756***	-23.737***	-24.454***	-25.226***	3.896	5.653	4.151	0.018	-0.476	5.263
	(6.946)	(7.388)	(7.087)	(6.061)	(6.255)	(7.462)	(6.189)	(6.989)	(5.676)	(5.455)	(5.483)	(6.954)
Rlp·Volcker ·Connect (γ_3)	46.192*	-1.349	4.756	47.998***	19.667	34.587*	-38.793***	-35.470**	-46.459***	-27.258**	-19.055*	-32.060**
	(24.052)	(20.197)	(24.906)	(16.988)	(16.683)	(18.328)	(13.700)	(14.639)	(16.372)	(11.133)	(11.244)	(12.836)
X (δ)	-0.099***	0.028**	0.333***	0.209***	-0.044***	-0.070*	-0.115***	0.014	0.402***	0.207***	-0.036**	-0.030
	(0.012)	(0.013)	(0.031)	(0.022)	(0.015)	(0.038)	(0.011)	(0.013)	(0.030)	(0.021)	(0.015)	(0.037)
Rlp·X (η_0)	-9.145**	12.202***	6.717*	16.444***	-15.545***	-15.901***	-5.609	4.817	-2.281	1.371	-5.060	-7.902**
	(3.877)	(3.818)	(3.977)	(4.219)	(4.330)	(4.019)	(3.886)	(3.296)	(3.822)	(3.951)	(3.820)	(3.532)
Rlp·Volcker·X (η_1)	-116.270***	-30.456**	41.325***	8.020	30.683**	25.177*	46.250***	-7.271	15.558*	-23.754***	5.500	2.816
	(15.156)	(12.419)	(12.784)	(13.629)	(14.642)	(14.929)	(8.727)	(8.188)	(8.519)	(8.971)	(9.675)	(9.464)
Rlp·Connect·X (η_2)	-25.541**	-14.554	17.962*	3.505	2.947	3.425	-17.824	-9.697	-19.171*	-4.535	4.736	-14.319
	(11.968)	(10.976)	(10.866)	(14.076)	(12.986)	(11.777)	(12.512)	(9.545)	(10.903)	(13.211)	(11.079)	(10.250)
Rlp·Volcker·Connect ·X (η_3)	-23.852	34.907	34.402	-45.066	-15.145	-12.618	46.565**	15.663	52.705**	12.300	-39.211	29.666
	(38.187)	(29.264)	(31.014)	(39.654)	(34.704)	(34.789)	(23.400)	(20.404)	(22.287)	(26.805)	(26.310)	(22.148)
Constant	0.620***	0.530***	0.488***	0.518***	0.555***	0.616***	0.658***	0.571***	0.499***	0.551***	0.587***	0.632***
	(0.004)	(0.010)	(0.009)	(0.007)	(0.008)	(0.015)	(0.004)	(0.010)	(0.009)	(0.007)	(0.008)	(0.015)
R-squared	0.045	0.045	0.045	0.045	0.045	0.045	0.049	0.049	0.049	0.049	0.049	0.049
Number of HFs	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655
Fund fixed effect	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
Fung and Hsieh 7 factors	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 13: The Volcker Rule and hedge funds' liquidity provision by investment style category

This table compares the impact of the Volcker Rule on directional, non-directional and semi-directional funds' liquidity provision. Rlp^{Liquid} and $Rlp^{Illiquid}$ represent the returns from providing liquidity calculated based on the method proposed by Jylhä et al. (2014) for stocks with the Amihud illiquidity measure below and above the median respectively, $Volcker$ is a dummy variable that equals 1 after April 2014, *Connect* is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

$Rlp =$	(1)	(2)	(3)	(4)	(5)	(6)
		Rlp^{Liquid}			$Rlp^{Illiquid}$	
	Directional	Non-directional	Semi-directional	Directional	Non-directional	Semi-directional
Rlp (γ_0)	22.029***	-17.358***	-10.141***	73.289***	41.871***	92.533***
	(4.094)	(3.596)	(2.457)	(4.621)	(4.592)	(2.431)
Rlp·Volcker (γ_1)	-39.751**	35.627***	-1.742	-141.585***	-15.471**	-57.928***
	(16.160)	(11.412)	(8.347)	(11.361)	(7.480)	(5.545)
Rlp·Connect (γ_2)	7.999	-6.017	-8.742	4.557	7.442	0.912
	(15.510)	(14.596)	(7.759)	(12.940)	(12.397)	(6.872)
Rlp·Volcker ·Connect (γ_3)	50.823	7.863	-2.237	57.231*	-12.892	-1.717
	(46.872)	(34.658)	(26.221)	(33.614)	(21.296)	(18.398)
MKT	1.030***	0.731***	0.392**	1.314***	0.908***	0.792***
	(0.296)	(0.281)	(0.155)	(0.296)	(0.283)	(0.153)
SMB	0.999**	1.355***	0.345	2.249***	1.729***	1.515***
	(0.505)	(0.315)	(0.236)	(0.510)	(0.325)	(0.238)
TERM	-1.327***	-0.976***	-0.036	-1.182***	-0.993***	0.028
	(0.086)	(0.086)	(0.035)	(0.085)	(0.086)	(0.034)
CREDIT	-2.446***	-3.618***	-3.749***	-2.645***	-3.813***	-4.112***
	(0.147)	(0.184)	(0.074)	(0.154)	(0.194)	(0.076)
PTFSBD	-0.551***	-1.582***	-1.923***	-0.403***	-1.559***	-1.828***
	(0.127)	(0.096)	(0.057)	(0.127)	(0.095)	(0.057)
PTFSFX	2.171***	0.243***	0.943***	2.381***	0.262***	1.078***
	(0.110)	(0.052)	(0.037)	(0.114)	(0.055)	(0.037)
PTFSCOM	1.190***	-1.078***	-1.022***	1.264***	-1.091***	-0.997***
	(0.136)	(0.079)	(0.049)	(0.139)	(0.080)	(0.050)
Constant	0.585***	0.437***	0.626***	0.621***	0.452***	0.657***
	(0.004)	(0.004)	(0.002)	(0.004)	(0.004)	(0.002)
R-squared	0.015	0.079	0.069	0.017	0.080	0.075
Number of HFs	1,922	1,380	4,703	1,922	1,380	4,703
Fund fixed effect	Yes	Yes	Yes	Yes	Yes	Yes

Table 14: The Volcker Rule and hedge funds' liquidity provision to liquid stocks by investment strategy

This table reports the impact of the Volcker Rule on hedge funds' liquidity provision by different investment strategies. Rlp^{Liquid} represents the returns from providing liquidity calculated based on the method proposed by Jylhä et al. (2014) and using stocks with Amihud illiquidity measure below the median, $Volcker$ is a dummy variable that equals 1 after April 2014, and $Connect$ is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Long/Short Equities	(2) Emerging Markets	(3) Global Macro	(4) Managed Futures	(5) Fixed Income	(6) Equity Market Neutral	(7) Relative Value	(8) Event Driven	(9) Multi Strategy	(10) Others
Rlp^{Liquid} (γ_0)	-2.393	6.470	5.019	45.144***	-6.525**	-18.497***	-17.072*	-27.154***	-13.667***	-21.975***
	(3.701)	(11.991)	(6.410)	(4.970)	(3.276)	(5.698)	(9.162)	(4.228)	(2.955)	(6.853)
Rlp^{Liquid} ·Volcker (γ_1)	-35.250***	-188.107***	5.033	-74.553***	26.374**	-49.008	53.781**	-90.831***	49.065***	115.546***
	(11.265)	(71.733)	(21.781)	(21.676)	(11.107)	(41.377)	(27.089)	(33.684)	(12.339)	(20.903)
Rlp^{Liquid} ·Connect (γ_2)	-5.872	22.238	-6.160	-78.880***	8.279	-3.995	-92.488***	-19.438	-11.585	3.750
	(10.853)	(48.202)	(26.436)	(24.306)	(10.429)	(17.917)	(33.509)	(18.795)	(10.115)	(24.179)
Rlp^{Liquid}·Volcker ·Connect (γ_3)	24.725	118.978	104.460*	128.130*	-12.538	-52.557	98.511	-42.458	-20.428	56.111
	(34.332)	(154.536)	(61.670)	(67.933)	(35.853)	(65.114)	(91.792)	(123.147)	(39.695)	(73.938)
MKT	-0.085	-2.688***	0.106	2.297***	0.877***	1.260***	-1.169*	4.497***	0.041	-2.854***
	(0.215)	(0.829)	(0.431)	(0.414)	(0.326)	(0.367)	(0.674)	(0.409)	(0.234)	(0.558)
SMB	0.424	11.492***	0.026	-1.804***	1.553***	0.963	-0.453	1.981***	-0.424	-2.224***
	(0.343)	(1.554)	(0.627)	(0.564)	(0.307)	(0.622)	(0.938)	(0.417)	(0.327)	(0.840)
TERM	0.111**	-0.848***	-0.913***	-1.703***	-1.113***	-0.134	-0.259	-0.260***	-0.381***	-0.681***
	(0.049)	(0.176)	(0.146)	(0.118)	(0.094)	(0.105)	(0.175)	(0.070)	(0.057)	(0.124)
CREDIT	-4.215***	-7.863***	-1.694***	-1.128***	-3.177***	-1.076***	-5.048***	-3.775***	-2.619***	-6.791***
	(0.104)	(0.408)	(0.198)	(0.149)	(0.151)	(0.173)	(0.466)	(0.184)	(0.111)	(0.274)
PTFSBD	-2.150***	-4.194***	-1.069***	0.586***	-1.454***	-0.843***	-2.461***	-2.144***	-1.383***	-3.303***
	(0.079)	(0.283)	(0.181)	(0.173)	(0.095)	(0.154)	(0.304)	(0.136)	(0.093)	(0.212)
PTFSFX	1.128***	1.083***	1.783***	2.729***	0.243***	0.229**	0.715***	0.572***	0.613***	1.609***
	(0.050)	(0.205)	(0.157)	(0.167)	(0.054)	(0.093)	(0.159)	(0.075)	(0.063)	(0.124)
PTFSCOM	-1.109***	-1.723***	0.176	2.558***	-0.932***	0.001	-1.978***	-1.287***	-0.666***	-2.504***
	(0.068)	(0.284)	(0.134)	(0.200)	(0.066)	(0.140)	(0.226)	(0.122)	(0.074)	(0.139)
Constant	0.645***	0.612***	0.547***	0.602***	0.423***	0.457***	0.553***	0.592***	0.598***	0.564***
	(0.003)	(0.009)	(0.006)	(0.006)	(0.004)	(0.005)	(0.009)	(0.004)	(0.003)	(0.007)
R-squared	0.067	0.114	0.013	0.032	0.096	0.020	0.110	0.126	0.056	0.127
Number of HFs	2,910	317	567	1,008	852	254	274	459	1,364	681

Table 15: The Volcker Rule and hedge funds' liquidity provision to illiquid stocks by investment strategy

This table reports the impact of the Volcker Rule on hedge funds' liquidity provision by different investment strategies. $Rlp^{Illiquid}$ represents the returns from providing liquidity calculated based on the method proposed by Jylhä et al. (2014) and using stocks with Amihud illiquidity measure above the median, $Volcker$ is a dummy variable that equals 1 after April 2014, and $Connect$ is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Long/Short Equities	(2) Emerging Markets	(3) Global Macro	(4) Managed Futures	(5) Fixed Income	(6) Equity Market Neutral	(7) Relative Value	(8) Event Driven	(9) Multi Strategy	(10) Others
$Rlp^{Illiquid}$ (γ_0)	102.623***	159.989***	44.157***	64.019***	26.048***	30.948***	75.212***	61.216***	67.370***	138.850***
	(3.543)	(11.697)	(7.253)	(5.622)	(3.843)	(6.092)	(12.466)	(4.977)	(3.778)	(8.646)
$Rlp^{Illiquid}$ ·Volcker (γ_1)	-44.162***	-237.208***	-48.310***	-190.892***	-16.812**	-23.765	-18.535	-106.397***	-60.515***	-49.545***
	(8.005)	(43.561)	(14.775)	(15.900)	(6.637)	(25.453)	(18.599)	(20.058)	(7.508)	(14.422)
$Rlp^{Illiquid}$ ·Connect (γ_2)	3.522	27.555	7.986	-2.979	-1.344	23.972	-12.900	-9.689	4.393	-32.332*
	(8.895)	(28.782)	(20.634)	(19.520)	(10.005)	(23.279)	(36.199)	(18.457)	(11.761)	(18.528)
$Rlp^{Illiquid}$·Volcker ·Connect (γ_3)	-4.540	178.908*	62.792	40.195	-7.057	-1.203	-29.436	-106.914**	19.389	62.591
	(23.849)	(96.145)	(40.605)	(48.602)	(17.948)	(56.979)	(71.631)	(54.357)	(29.102)	(38.006)
MKT	0.431**	-2.085***	0.353	2.452***	0.861***	1.281***	-0.749	4.536***	0.297	-1.983***
	(0.212)	(0.795)	(0.431)	(0.421)	(0.294)	(0.381)	(0.673)	(0.416)	(0.229)	(0.538)
SMB	1.804***	13.831***	0.574	-0.385	1.661***	1.378**	0.141	2.668***	0.341	-0.980
	(0.348)	(1.548)	(0.618)	(0.563)	(0.293)	(0.624)	(0.939)	(0.421)	(0.325)	(0.844)
TERM	0.213***	-0.584***	-0.862***	-1.523***	-0.979***	-0.152	-0.280*	-0.273***	-0.359***	-0.624***
	(0.048)	(0.179)	(0.143)	(0.116)	(0.082)	(0.106)	(0.170)	(0.068)	(0.056)	(0.120)
CREDIT	-4.566***	-8.411***	-1.843***	-1.252***	-2.907***	-1.264***	-5.398***	-4.058***	-2.950***	-7.359***
	(0.107)	(0.410)	(0.206)	(0.156)	(0.128)	(0.180)	(0.499)	(0.187)	(0.121)	(0.291)
PTFSBD	-2.043***	-3.942***	-1.002***	0.764***	-1.404***	-0.835***	-2.399***	-2.117***	-1.307***	-3.158***
	(0.078)	(0.280)	(0.179)	(0.174)	(0.087)	(0.154)	(0.296)	(0.135)	(0.092)	(0.210)
PTFSFX	1.259***	1.454***	1.875***	2.984***	0.292***	0.260***	0.776***	0.616***	0.774***	1.791***
	(0.051)	(0.217)	(0.163)	(0.172)	(0.053)	(0.097)	(0.171)	(0.075)	(0.065)	(0.130)
PTFSCOM	-1.072***	-1.505***	0.167	2.668***	-0.862***	0.045	-2.043***	-1.188***	-0.681***	-2.606***
	(0.070)	(0.291)	(0.138)	(0.204)	(0.060)	(0.136)	(0.232)	(0.123)	(0.075)	(0.145)
Constant	0.669***	0.658***	0.571***	0.642***	0.449***	0.461***	0.591***	0.596***	0.643***	0.638***
	(0.003)	(0.011)	(0.007)	(0.006)	(0.004)	(0.005)	(0.011)	(0.004)	(0.004)	(0.009)
R-squared	0.074	0.122	0.015	0.033	0.098	0.022	0.112	0.129	0.060	0.134
Number of HFs	2,910	317	567	1,008	852	254	274	459	1,364	681

Table 16: The Volcker Rule and hedge funds' flow-performance relationship: the implementation period

This table reports the estimation results for the impact of the Volcker Rule on hedge funds' flow-performance relationship. $Flow_t$ is the flow for fund i in month t and $\overline{Flow^i}_{t:t+11}$ is the average monthly flow for fund i from month t to $t+11$. *Ret* is the average past year return, $Volcker$ is a dummy variable that equals 1 after April 2014, *Dodd* is a dummy variable that equal 1 between July 2010 and March 2014, *Prime* is a dummy variable that equals 1 if a US-based LCFI is a prime broker of a hedge fund and *Connect* is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
		$Flow_t$			$\overline{Flow}_{t:t+11}$	
Ret (β_0)	0.005***	0.006***	0.005***	0.053***	0.055***	0.055***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.002)
Dodd (γ_0^{Dodd})	-0.002***	-0.001**	-0.001**	-0.140***	-0.131***	-0.127***
	(0.001)	(0.001)	(0.001)	(0.009)	(0.009)	(0.010)
Volcker (γ_0)	-0.006***	-0.005***	-0.005***	-0.283***	-0.255***	-0.258***
	(0.001)	(0.001)	(0.001)	(0.012)	(0.012)	(0.013)
Ret·Dodd (β_1^{Dodd})	0.002***	0.002***	0.002***	0.014***	0.015***	0.011***
	(0.000)	(0.000)	(0.000)	(0.004)	(0.004)	(0.004)
Ret·Volcker (β_1)	0.000	0.000	0.000	0.060***	0.048***	0.049***
	(0.000)	(0.000)	(0.000)	(0.006)	(0.006)	(0.007)
Prime (γ_1)	-0.002*		-0.001	0.023		0.061*
	(0.001)		(0.001)	(0.032)		(0.032)
Dodd·Prime (γ_2^{Dodd})	0.003**		0.003*	-0.026		-0.037*
	(0.001)		(0.001)	(0.022)		(0.022)
Volcker·Prime (γ_2)	0.001		0.000	0.062**		0.041
	(0.002)		(0.002)	(0.030)		(0.030)
Ret·Prime (β_2)	0.002***		0.002***	-0.002		-0.004
	(0.000)		(0.000)	(0.004)		(0.004)
Ret·Dodd·Prime (β_3^{Dodd})	0.001		0.002**	0.049***		0.052***
	(0.001)		(0.001)	(0.013)		(0.013)
Ret·Volcker·Prime (β_3)	0.003***		0.004***	-0.025		-0.015
	(0.001)		(0.001)	(0.020)		(0.020)
Connect (γ_1)		0.010***	0.010***		0.402***	0.408***
		(0.001)	(0.001)		(0.035)	(0.036)
Dodd·Connect (γ_2^{Dodd})		-0.008***	-0.008***		-0.102***	-0.105***
		(0.002)	(0.002)		(0.022)	(0.023)
Volcker·Connect (γ_2)		-0.010***	-0.010***		-0.196***	-0.194***
		(0.002)	(0.002)		(0.028)	(0.028)
Ret·Connect (β_2)		-0.001***	-0.001*		-0.016***	-0.016***
		(0.000)	(0.000)		(0.004)	(0.004)
Ret·Dodd·Connect (β_3^{Dodd})		0.005***	0.005***		0.021*	0.024**
		(0.001)	(0.001)		(0.012)	(0.012)
Ret·Volcker·Connect (β_3)		0.001	0.001		0.082***	0.082***
		(0.001)	(0.001)		(0.017)	(0.017)
Constant	0.015***	0.014***	0.014***	1.379***	1.350***	1.342***
	(0.002)	(0.002)	(0.002)	(0.044)	(0.044)	(0.044)
R-squared	0.0004	0.0004	0.0004	0.0133	0.0133	0.0133
Number of HFs	6,788	6,788	6,788	6,191	6,191	6,191
Other HF specific controls	yes	yes	yes	yes	yes	yes

Table 17: The Volcker Rule and hedge funds' market liquidity exposure: the implementation period

This table reports the estimation results for the impact of the Volcker Rule on hedge funds' exposure to market liquidity risk. *LIQ* represents the Pástor and Stambaugh (2003) market liquidity factor, *Volcker* is a dummy variable that equals 1 after April 2014, *Dodd* is a dummy variable that equal 1 between July 2010 and March 2014, *Prime* is a dummy variable that equals 1 if a US-based LCFI is a prime broker of a hedge fund, and *Connect* is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Prime	(2) Connect	(3) Both
LIQ (γ_0)	4.822***	4.760***	4.351**
	(1.697)	(1.600)	(1.866)
LIQ·Dodd (γ_1)	0.143	-0.236	0.102
	(1.487)	(1.389)	(1.658)
LIQ·Volcker (γ_1)	-6.286***	-6.210***	-5.852***
	(1.747)	(1.654)	(1.920)
LIQ·Prime (γ_2)	2.141		2.460
	(1.584)		(1.695)
LIQ·Dodd·Prime (γ_3)	-1.973		-1.918
	(1.739)		(1.844)
LIQ·Volcker·Prime (γ_3)	-1.762		-2.054
	(1.823)		(1.925)
LIQ·Connect (γ_2)		3.941**	4.211**
		(1.536)	(1.696)
LIQ·Dodd·Connect (γ_3)		-0.555	-0.772
		(1.608)	(1.765)
LIQ·Volcker·Connect (γ_3)		-3.749**	-3.979**
		(1.773)	(1.918)
MKT	-0.829	-0.827	-0.830
	(1.756)	(1.754)	(1.756)
SMB	-1.047*	-1.046*	-1.041*
	(0.552)	(0.552)	(0.549)
TERM	-0.740**	-0.737**	-0.738**
	(0.348)	(0.347)	(0.347)
CREDIT	-4.184***	-4.181***	-4.181***
	(0.695)	(0.694)	(0.694)
PTFSBD	-1.703***	-1.700***	-1.702***
	(0.256)	(0.258)	(0.257)
PTFSFX	1.456***	1.456***	1.455***
	(0.143)	(0.143)	(0.143)
PTFSCOM	-0.539***	-0.538***	-0.539***
	(0.112)	(0.113)	(0.112)
Constant	0.638***	0.638***	0.638***
	(0.016)	(0.017)	(0.016)
R-squared	0.003	0.003	0.003
Number of HFs	8,655	8,655	8,655
Fund fixed effect	Yes	Yes	Yes

Table 18: The Volcker Rule and hedge funds' liquidity provision: the implementation period

This table reports the estimation results for the impact of the Volcker Rule on hedge funds' liquidity provision. *Rlp* represents the returns from providing liquidity calculated based on the method proposed by Jylhä et al. (2014), Rlp^{Liquid} and $Rlp^{Illiquid}$ are calculated using sub-samples of stocks with the Amihud measure below and above the median respectively, $Volcker$ is a dummy variable that equals 1 after April 2014, *Dodd* is a dummy variable that equal 1 between July 2010 and March 2014, *Prime* is a dummy variable that equals 1 if a US-based LCFI is a prime broker of a hedge fund, and *Connect* is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		Rlp			Rlp^{Liquid}			$Rlp^{Illiquid}$	
Rlp (γ_0)	-1.450***	-1.358***	-1.361***	-14.970	-10.347	-9.616	97.713***	96.657***	95.914***
	(0.223)	(0.203)	(0.269)	(10.395)	(9.456)	(12.672)	(14.291)	(13.640)	(15.449)
Rlp·Dodd (γ_1)	0.774**	0.696**	0.626	52.812***	49.470***	48.222**	-107.758***	-105.677***	-103.335***
	(0.357)	(0.338)	(0.404)	(17.374)	(16.585)	(19.751)	(16.657)	(16.094)	(17.843)
Rlp·Volcker (γ_1)	2.444***	2.296***	2.249***	27.109	17.374	21.979	-90.492***	-86.777***	-84.408***
	(0.212)	(0.194)	(0.257)	(19.798)	(19.006)	(22.234)	(6.360)	(6.162)	(7.464)
Rlp·Prime (γ_2)	0.078		0.018	-0.699		-4.364	3.174		4.442
	(0.388)		(0.417)	(19.586)		(21.047)	(11.782)		(12.534)
Rlp·Dodd·Prime (γ_3)	0.417		0.521	5.189		8.273	-13.401		-16.588
	(0.439)		(0.464)	(20.049)		(21.497)	(16.512)		(17.097)
Rlp·Volcker·Prime (γ_3)	0.217		0.356	-39.241		-35.758	-12.187		-16.628
	(0.462)		(0.487)	(26.151)		(27.388)	(16.318)		(16.999)
Rlp·Connect (γ_2)		-0.785*	-0.783*		-46.770**	-47.255**		15.527	16.027
		(0.426)	(0.464)		(21.107)	(23.022)		(12.438)	(13.428)
Rlp·Dodd·Connect (γ_3)		1.144**	1.196**		41.005*	41.869*		-31.673**	-33.356**
		(0.474)	(0.508)		(22.372)	(24.206)		(16.137)	(16.921)
Rlp·Volcker·Connect (γ_3)		1.378***	1.414***		49.205*	45.691		-40.675***	-42.384**
		(0.491)	(0.525)		(26.968)	(28.583)		(15.690)	(16.605)
MKT	-0.854	-0.853	-0.852	-1.282	-1.269	-1.270	-0.849	-0.847	-0.848
	(1.584)	(1.589)	(1.585)	(1.648)	(1.652)	(1.652)	(1.728)	(1.725)	(1.726)
SMB	1.166	1.169	1.168	0.359	0.351	0.351	1.822*	1.824*	1.824*
	(0.796)	(0.797)	(0.797)	(0.807)	(0.806)	(0.805)	(0.976)	(0.976)	(0.975)
TERM	-0.647**	-0.645**	-0.645**	-0.781**	-0.779**	-0.779**	-0.697**	-0.697**	-0.697**
	(0.323)	(0.324)	(0.324)	(0.318)	(0.319)	(0.319)	(0.339)	(0.339)	(0.339)
CREDIT	-4.169***	-4.167***	-4.167***	-4.467***	-4.465***	-4.465***	-4.774***	-4.776***	-4.776***
	(0.596)	(0.598)	(0.597)	(0.616)	(0.617)	(0.617)	(0.618)	(0.619)	(0.618)
PTFSBD	-1.540***	-1.539***	-1.539***	-1.585***	-1.585***	-1.585***	-1.488***	-1.488***	-1.488***
	(0.260)	(0.260)	(0.259)	(0.234)	(0.234)	(0.234)	(0.225)	(0.225)	(0.225)
PTFSFX	1.365***	1.365***	1.365***	1.412***	1.413***	1.413***	1.586***	1.587***	1.587***
	(0.151)	(0.151)	(0.151)	(0.154)	(0.154)	(0.154)	(0.137)	(0.138)	(0.138)
PTFSCOM	-0.672***	-0.671***	-0.671***	-0.630***	-0.629***	-0.629***	-0.570***	-0.570***	-0.570***
	(0.130)	(0.130)	(0.130)	(0.141)	(0.141)	(0.141)	(0.136)	(0.136)	(0.136)
Constant	0.679***	0.678***	0.678***	0.646***	0.646***	0.646***	0.651***	0.651***	0.651***
	(0.020)	(0.020)	(0.020)	(0.019)	(0.019)	(0.019)	(0.020)	(0.020)	(0.020)
R-squared	0.003	0.003	0.003	0.002	0.002	0.002	0.003	0.003	0.003
Number of HFs	8,655	8,655	8,655	8,686	8,686	8,686	8,686	8,686	8,686
Fund fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 19: The Volcker Rule and hedge funds' flow-performance relationship: funds linked to US and non-US LTCIs only

This table reports the estimation results for the impact of the Volcker Rule on hedge funds' flow-performance relationship. $Flow_t$ is the flow for fund i in month t and $\overline{Flow^i}_{t:t+11}$ is the average monthly flow for fund i from month t to $t+11$. *Ret* is the average past year return, $Volcker$ is a dummy variable that equals 1 after April 2014, $Prime$ is a dummy variable that equals 1 if a US-based LCFI is a prime broker of a hedge fund and $Connect$ is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. The sample includes only those funds that are linked to US-based and non-US-based LCFIs. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
		$Flow_t$			$\overline{Flow}_{t:t+11}$	
Ret (β_0)	0.004***	0.005***	0.004***	0.039***	0.043***	0.040***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Volcker (γ_0)	-0.004***	-0.002***	-0.003***	-0.090***	-0.047***	-0.059***
	(0.001)	(0.001)	(0.001)	(0.005)	(0.005)	(0.006)
Ret·Volcker (β_1)	-0.000	-0.000	-0.000	0.017***	0.016***	0.010***
	(0.000)	(0.000)	(0.000)	(0.003)	(0.003)	(0.004)
Prime (γ_1)	-0.000		-0.001*	0.001		-0.020*
	(0.001)		(0.001)	(0.010)		(0.010)
Volcker·Prime (γ_2)	0.002**		0.002***	0.014**		0.026***
	(0.001)		(0.001)	(0.007)		(0.007)
Ret·Prime (β_2)	0.002***		0.002***	0.008***		0.008***
	(0.000)		(0.000)	(0.001)		(0.001)
Ret·Volcker·Prime (β_3)	0.003***		0.002***	0.029***		0.024***
	(0.001)		(0.001)	(0.005)		(0.005)
Connect (γ_1)		0.002***	0.002***		0.095***	0.099***
		(0.001)	(0.001)		(0.010)	(0.010)
Volcker·Connect (γ_2)		-0.002**	-0.002***		-0.070***	-0.073***
		(0.001)	(0.001)		(0.007)	(0.007)
Ret·Connect (β_2)		0.000***	0.000		-0.001	-0.003**
		(0.000)	(0.000)		(0.001)	(0.001)
Ret·Volcker·Connect (β_3)		0.002***	0.001		0.030***	0.024***
		(0.001)	(0.001)		(0.005)	(0.005)
Constant	0.005***	0.003**	0.004***	0.637***	0.591***	0.600***
	(0.001)	(0.001)	(0.001)	(0.022)	(0.022)	(0.022)
R-squared	0.0182	0.0182	0.0182	0.0089	0.0089	0.0089
Number of HFs	4,056	4,056	4,056	3,837	3,837	3,837
Other HF specific controls	yes	yes	yes	yes	yes	yes

Table 20: The Volcker Rule and hedge funds' market liquidity exposure: funds linked to US and non-US LTCIs only

This table reports the estimation results for the impact of the Volcker Rule on hedge funds' exposure to market liquidity risk. *LIQ* represents the Pástor and Stambaugh (2003) market liquidity factor, *Volcker* is a dummy variable that equals 1 after April 2014, *Prime* is a dummy variable that equals 1 if a US-based LCFI is a prime broker of a hedge fund, and *Connect* is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. The sample includes only those funds that are linked to US-based and non-US-based LCFIs. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Prime	(2) Connect	(3) Both
LIQ (γ_0)	6.699***	6.126***	6.339***
	(0.287)	(0.249)	(0.320)
LIQ·Volcker (γ_1)	-7.817***	-7.105***	-7.315***
	(0.566)	(0.586)	(0.682)
LIQ·Prime (γ_2)	-0.247		-0.446
	(0.384)		(0.396)
LIQ·Volcker·Prime (γ_3)	0.200		0.445
	(0.769)		(0.779)
LIQ·Connect (γ_2)		0.844**	0.936**
		(0.370)	(0.382)
LIQ·Volcker·Connect (γ_3)		-1.148	-1.240
		(0.767)	(0.778)
MKT	0.740***	0.739***	0.740***
	(0.156)	(0.156)	(0.156)
SMB	-1.339***	-1.340***	-1.341***
	(0.253)	(0.253)	(0.253)
TERM	-0.230***	-0.230***	-0.230***
	(0.037)	(0.037)	(0.037)
CREDIT	-3.486***	-3.486***	-3.486***
	(0.075)	(0.075)	(0.075)
PTFSBD	-2.135***	-2.136***	-2.135***
	(0.062)	(0.062)	(0.062)
PTFSFX	1.304***	1.304***	1.304***
	(0.045)	(0.045)	(0.045)
PTFSCOM	-0.735***	-0.735***	-0.735***
	(0.055)	(0.055)	(0.055)
Constant	0.576***	0.576***	0.576***
	(0.002)	(0.002)	(0.002)
R-squared	0.066	0.066	0.066
Number of HFs	5,146	5,146	5,146
Fund fixed effect	Yes	Yes	Yes

Table 21: The Volcker Rule and hedge funds' liquidity provision: funds linked to US and non-US LTCIs only

This table reports the estimation results for the impact of the Volcker Rule on hedge funds' liquidity provision. *Rlp* represents the returns from providing liquidity calculated based on the method proposed by Jylhä et al. (2014), Rlp^{Liquid} and $Rlp^{Illiquid}$ are calculated using sub-samples of stocks with the Amihud measure below and above the median respectively, $Volcker$ is a dummy variable that equals 1 after April 2014, *Prime* is a dummy variable that equals 1 if a US-based LCFI is a prime broker of a hedge fund, and *Connect* is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. The sample includes only those funds that are linked to US-based and non-US-based LCFIs. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		Rlp			Rlp^{Liquid}			$Rlp^{Illiquid}$	
Rlp (γ_0)	-1.452***	-1.218***	-1.374***	-13.356***	-3.920	-8.646**	92.024***	88.267***	91.869***
	(0.070)	(0.060)	(0.077)	(3.284)	(3.122)	(3.688)	(3.274)	(3.199)	(3.657)
Rlp·Volcker (γ_1)	2.509***	2.172***	2.318***	18.315*	-8.642	11.822	-68.916***	-57.919***	-65.686***
	(0.146)	(0.151)	(0.173)	(10.408)	(11.150)	(12.881)	(6.888)	(7.255)	(8.193)
Rlp·Prime (γ_2)	0.283***		0.326***	7.577*		10.148**	-7.464*		-7.548*
	(0.094)		(0.097)	(4.603)		(4.708)	(3.976)		(4.099)
Rlp·Volcker·Prime (γ_3)	-0.216		-0.299	-47.325***		-50.537***	16.868*		18.077*
	(0.204)		(0.210)	(14.601)		(14.644)	(9.413)		(9.568)
Rlp·Connect (γ_2)		-0.134	-0.202**		-10.012**	-12.123**		-1.145	0.400
		(0.092)	(0.094)		(4.601)	(4.705)		(3.953)	(4.078)
Rlp·Volcker·Connect (γ_3)		0.386*	0.451**		7.435	16.060		-3.884	-7.191
		(0.204)	(0.210)		(14.744)	(14.778)		(9.449)	(9.600)
MKT	0.380**	0.377**	0.380**	0.242	0.239	0.244	0.630***	0.627***	0.630***
	(0.157)	(0.157)	(0.157)	(0.159)	(0.159)	(0.159)	(0.157)	(0.157)	(0.157)
SMB	1.313***	1.309***	1.314***	0.421*	0.422*	0.419	1.559***	1.560***	1.559***
	(0.255)	(0.255)	(0.255)	(0.256)	(0.256)	(0.256)	(0.256)	(0.256)	(0.256)
TERM	-0.133***	-0.134***	-0.133***	-0.272***	-0.273***	-0.272***	-0.210***	-0.210***	-0.210***
	(0.037)	(0.037)	(0.037)	(0.038)	(0.038)	(0.038)	(0.037)	(0.037)	(0.037)
CREDIT	-3.584***	-3.585***	-3.584***	-3.833***	-3.834***	-3.833***	-4.179***	-4.177***	-4.179***
	(0.074)	(0.074)	(0.074)	(0.079)	(0.079)	(0.079)	(0.082)	(0.082)	(0.082)
PTFSBD	-2.004***	-2.001***	-2.004***	-1.955***	-1.955***	-1.955***	-1.862***	-1.863***	-1.862***
	(0.062)	(0.062)	(0.062)	(0.062)	(0.062)	(0.062)	(0.061)	(0.061)	(0.061)
PTFSFX	1.188***	1.187***	1.188***	1.220***	1.220***	1.220***	1.356***	1.355***	1.356***
	(0.045)	(0.045)	(0.045)	(0.044)	(0.044)	(0.044)	(0.045)	(0.045)	(0.045)
PTFSCOM	-0.844***	-0.847***	-0.844***	-0.862***	-0.862***	-0.861***	-0.841***	-0.841***	-0.841***
	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.055)	(0.055)	(0.055)
Constant	0.620***	0.620***	0.620***	0.586***	0.586***	0.586***	0.618***	0.618***	0.618***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
R-squared	0.062	0.062	0.062	0.058	0.058	0.058	0.062	0.062	0.062
Number of HFs	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146
Fund fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Appendix A Results for the Traded Liquidity Measure

In this appendix we report the results for the changes in the liquidity exposure of hedge funds after the implementation of the Volcker Rule using the traded liquidity measure of Pástor and Stambaugh (2003). The interpretation of the results remain qualitatively unchanged compared to the main results we discuss in the paper. Tables A1 to A4 report the detailed results.

[Tables A1 to A4 in here]

Table A1: The Volcker Rule and hedge funds' market liquidity exposure: traded liquiduty

This table reports the estimation results for the impact of the Volcker Rule on hedge funds' exposure to market liquidity risk. *TradeLiq* represents the Pástor and Stambaugh (2003) traded liquidity factor, *Volcker* is a dummy variable that equals 1 after April 2014, *Prime* is a dummy variable that equals 1 if a US-based LCFI is a prime broker of a hedge fund, and *Connect* is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Prime	(2) Connect	(3) Both
TradeLiq (γ_0)	4.896**	4.772**	4.110*
	(1.996)	(1.915)	(2.242)
TradeLiq·Volcker (γ_1)	-9.170***	-7.855***	-7.595***
	(2.543)	(2.479)	(2.752)
TradeLiq·Prime (γ_2)	3.554*		4.090*
	(2.130)		(2.285)
TradeLiq·Volcker·Prime (γ_3)	0.110		-1.006
	(2.867)		(2.991)
TradeLiq·Connect (γ_2)		5.970***	6.414***
		(2.227)	(2.418)
TradeLiq·Volcker·Connect (γ_3)		-11.005***	-11.141***
		(2.731)	(2.893)
MKT	-1.190	-1.195	-1.195
	(1.676)	(1.678)	(1.678)
SMB	-0.255	-0.252	-0.249
	(0.676)	(0.676)	(0.675)
TERM	-0.888***	-0.887***	-0.887***
	(0.313)	(0.313)	(0.313)
CREDIT	-4.243***	-4.242***	-4.242***
	(0.690)	(0.690)	(0.689)
PTFSBD	-1.616***	-1.613***	-1.613***
	(0.242)	(0.242)	(0.242)
PTFSFX	1.407***	1.405***	1.406***
	(0.145)	(0.145)	(0.145)
PTFSCOM	-0.601***	-0.600***	-0.603***
	(0.134)	(0.135)	(0.134)
Constant	0.619***	0.620***	0.620***
	(0.027)	(0.027)	(0.027)
R-squared	0.003	0.003	0.003
Number of HFs	8,655	8,655	8,655
Fund fixed effect	Yes	Yes	Yes

Table A2: The Volcker Rule and hedge funds' market liquidity exposure by fund characteristics: traded liquidity

This table reports the impact of the Volcker Rule on hedge funds' exposure to market liquidity risk after controlling for fund characteristics. $TradeLiq$ is the Pástor and Stambaugh (2003) traded liquidity factor, $Volcker$ is a dummy variable that equals 1 after April 2014, and $Connect$ is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. X indicates hedge fund characteristics: $Weak$ equals 1 for funds with returns below the median in each hedge fund category; $Lever$ equals 1 if a fund uses leverage; $Young$ equals 1 if a fund's age is below the median across all live funds; $Small$ equals 1 if a fund's assets under management are below the median; $Lock$ equals 1 for funds with lock-up periods; $LowRed$ equals 1 for funds with a total redemption period. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

$X =$	(1) Weak	(2) Lever	(3) Young	(4) Small	(5) Lock	(6) LowRed
TradeLiq (γ_0)	7.850***	6.998***	5.104**	6.603***	5.164**	5.510***
	(0.724)	(0.698)	(2.462)	(0.694)	(2.288)	(0.872)
TradeLiq·Volcker (γ_1)	-13.885***	-10.180***	-8.939***	-8.786***	-8.242***	-8.323***
	(1.911)	(1.931)	(2.965)	(1.868)	(2.998)	(1.007)
TradeLiq·Connect (γ_2)	5.097***	2.843*	7.613***	4.181***	5.670**	3.353
	(1.426)	(1.659)	(2.876)	(1.317)	(2.464)	(2.053)
TradeLiq·Volcker ·Connect (γ_3)	-9.758***	-8.738***	-14.218***	-10.276***	-10.125***	-8.065***
	(2.565)	(2.910)	(3.896)	(2.200)	(3.006)	(2.766)
X (δ)	0.057	0.112	0.276***	0.533**	-0.040	-0.179***
	(0.079)	(0.071)	(0.041)	(0.234)	(0.073)	(0.049)
TradeLiq·X (η_0)	-7.538*	-3.806	-1.601	-5.724	-0.969	-1.624
	(3.869)	(3.308)	(2.646)	(5.008)	(3.651)	(4.117)
TradeLiq·Volcker·X (η_1)	13.818***	3.970	3.222	3.482	0.819	0.505
	(3.900)	(3.508)	(2.998)	(5.023)	(3.913)	(4.456)
TradeLiq·Connect·X (η_2)	1.960	5.696	-5.737*	5.550	0.714	5.719
	(4.038)	(4.008)	(3.229)	(5.285)	(4.527)	(4.729)
TradeLiq·Volcker ·Connect·X (η_3)	-2.540	-4.135	8.352*	-2.539	-4.056	-6.743
	(4.656)	(5.116)	(4.359)	(6.205)	(6.193)	(5.752)
Constant	0.596***	0.528***	0.536***	0.443***	0.594***	0.692***
	(0.013)	(0.024)	(0.037)	(0.052)	(0.065)	(0.037)
R-squared	0.003	0.003	0.003	0.003	0.003	0.003
Number of HFs	8,655	8,655	8,655	8,655	8,655	8,655
Fund fixed effect	Yes	No	Yes	Yes	No	Yes
Fung and Hsieh 7 factors	Yes	Yes	Yes	Yes	Yes	Yes

Table A3: The Volcker Rule and hedge funds' market liquidity exposure by investment style category: traded liquidity

This table compares the impact of the Volcker Rule on directional, non-directional and semi-directional funds' exposure to market liquidity risk. *TradedLiq* represents the Pástor and Stambaugh (2003) traded liquidity factor, *Volcker* is a dummy variable that equals 1 after April 2014, and *Connect* is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Directional	(2) Non-directional	(3) Semi-directional
TradeLiq (γ_0)	7.844***	2.926*	4.179
	(0.612)	(1.655)	(3.347)
TradeLiq·Volcker (γ_1)	-15.722***	-12.024**	-3.176
	(1.884)	(6.114)	(4.006)
TradeLiq·Connect (γ_2)	4.573	9.269	3.443
	(3.959)	(5.779)	(3.320)
TradeLiq·Volcker·Connect (γ_3)	-7.272	-11.830*	-6.521
	(5.925)	(6.332)	(4.049)
MKT	1.418***	0.857**	-2.605
	(0.358)	(0.425)	(3.003)
SMB	0.884	0.415	-0.577
	(0.640)	(0.836)	(1.155)
TERM	-1.574***	0.329	-0.834**
	(0.105)	(1.499)	(0.409)
CREDIT	-2.533***	-0.812	-5.201***
	(0.195)	(2.814)	(1.023)
PTFSBD	-0.663***	-2.184***	-1.627***
	(0.173)	(0.506)	(0.412)
PTFSFX	2.426***	0.824	1.153***
	(0.131)	(0.631)	(0.200)
PTFSCOM	1.208***	-0.739**	-0.995***
	(0.171)	(0.364)	(0.216)
Constant	0.564***	0.496***	0.682***
	(0.006)	(0.014)	(0.048)
R-squared	0.014	0.001	0.003
Number of HFs	1,922	1,380	4,703
Fund fixed effect	Yes	Yes	Yes

Table A4: The Volcker Rule and hedge funds' market liquidity exposure by investment strategy: traded liquidity

This table reports the impact of the Volcker Rule on hedge funds' exposure to market liquidity risk by different investment strategies. *TradeLiq* represents the Pástor and Stambaugh (2003) traded liquidity factor, *Volcker* is a dummy variable that equals 1 after April 2014, and *Connect* is a dummy variable that equals 1 if a US-based LCFI is an administrator, auditor, custodian or advisor of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Long/Short Equities	(2) Emerging Markets	(3) Global Macro	(4) Managed Futures	(5) Fixed Income	(6) Equity Market Neutral	(7) Relative Value	(8) Event Driven	(9) Multi Strategy	(10) Other
TradeLiq (γ_0)	8.007***	12.786***	6.173***	5.046***	2.162***	4.678***	4.660**	7.858***	4.744***	3.736***
	(0.455)	(0.753)	(1.058)	(0.705)	(0.367)	(0.804)	(1.842)	(0.839)	(0.410)	(0.976)
TradeLiq ·Volcker (γ_1)	-5.794***	-15.417***	-12.279***	-21.660***	-4.444***	-3.965	-7.302**	-17.351***	-7.593***	-10.236***
	(1.240)	(2.697)	(2.838)	(2.704)	(0.829)	(4.296)	(3.234)	(3.180)	(0.960)	(2.060)
TradeLiq ·Connect (γ_2)	-1.998	-0.556	-3.160	10.305*	-0.360	4.460**	22.338***	-5.396**	6.588***	7.402**
	(1.641)	(4.191)	(3.597)	(5.347)	(1.171)	(2.061)	(7.908)	(2.440)	(2.293)	(3.632)
TradeLiq·Volcker ·Connect (γ_3)	2.261	-14.728	-0.106	-12.027	-3.411*	-4.849	-23.149*	17.833**	-19.889***	-15.320***
	(3.300)	(12.615)	(6.205)	(9.264)	(1.924)	(6.288)	(13.957)	(8.401)	(4.452)	(5.652)
MKT	-0.154	-1.454*	0.178	2.649***	0.799***	1.158***	-0.887	5.015***	-0.023	-2.825***
	(0.251)	(0.799)	(0.576)	(0.493)	(0.290)	(0.382)	(0.693)	(0.506)	(0.227)	(0.544)
SMB	0.779*	7.952***	-0.744	-2.349***	1.065***	0.355	-1.113	1.570***	-1.070***	-3.112***
	(0.434)	(1.519)	(0.843)	(0.718)	(0.285)	(0.617)	(1.043)	(0.587)	(0.324)	(0.841)
TERM	-0.251***	-0.683***	-1.176***	-1.739***	-1.021***	-0.294***	-0.806***	-0.726***	-0.527***	-0.825***
	(0.059)	(0.177)	(0.187)	(0.145)	(0.084)	(0.103)	(0.201)	(0.107)	(0.056)	(0.118)
CREDIT	-4.592***	-7.101***	-1.731***	-0.947***	-2.724***	-0.918***	-5.690***	-4.460***	-2.436***	-6.606***
	(0.135)	(0.384)	(0.256)	(0.207)	(0.122)	(0.172)	(0.554)	(0.293)	(0.106)	(0.267)
PTFSBD	-2.235***	-4.445***	-1.250***	0.755***	-1.449***	-0.875***	-2.426***	-2.432***	-1.433***	-3.352***
	(0.090)	(0.285)	(0.241)	(0.242)	(0.088)	(0.155)	(0.312)	(0.168)	(0.093)	(0.213)
PTFSFX	1.161***	1.286***	2.104***	2.989***	0.288***	0.228**	0.623***	0.509***	0.613***	1.619***
	(0.055)	(0.205)	(0.223)	(0.195)	(0.051)	(0.093)	(0.165)	(0.094)	(0.063)	(0.124)
PTFSCOM	-1.306***	-1.373***	0.170	2.910***	-0.812***	-0.032	-2.130***	-1.461***	-0.610***	-2.406***
	(0.082)	(0.284)	(0.175)	(0.244)	(0.059)	(0.134)	(0.266)	(0.150)	(0.073)	(0.138)
Constant	0.615***	0.613***	0.545***	0.608***	0.433***	0.417***	0.528***	0.528***	0.587***	0.567***
	(0.004)	(0.009)	(0.009)	(0.008)	(0.004)	(0.007)	(0.010)	(0.008)	(0.003)	(0.007)
R-squared	0.062	0.130	0.013	0.025	0.095	0.026	0.127	0.112	0.060	0.128
Number of HFs	2,910	317	567	1,008	852	254	274	459	1,364	681

Appendix B Hedge Funds' Characteristics and the Effect of Prime-Brokerage Connections

This section examines the role of the prime brokerage relationship between LCFIs and hedge funds with different characteristics and investment styles. In Table B1, the coefficients γ_3 on $LIQ \cdot Volcker \cdot Prime$ and η_3 on $LIQ \cdot Volcker \cdot Prime \cdot X$ are always insignificant, suggesting that the effects of the Volcker Rule are not significantly stronger for funds having a prime brokerage relationship with LCFIs. Similarly, Table B2 shows that prime brokerage relation does not alter the effect of the Rule for different classes of hedge fund strategies (directional, non-directional funds, or semi-directional funds). The only cases in which prime brokerage connections mediate the effect of the Volcker Rule are in relation to Global Macro and Fixed income funds. Table B3 shows that following the Rule, connected funds in the Global Macro style decrease their exposure to market liquidity even more than other types of funds, while connected funds in the Fixed Income style do not reduce their exposure to market liquidity as compared to other funds.

Similarly, Table B4 indicates that prime brokerage connections do not alter the effect of the Volcker Rule on hedge fund liquidity provision, with the only exception being in funds with a lockup period. These funds are less likely to supply liquidity to illiquid stocks before the Rule, but have significantly increased liquidity provision afterwards. Table B5 shows that the effect of the prime brokerage connections is only significant for semi-directional funds. These funds are less likely to provide liquidity to liquid stocks prior to the Volcker Rule, but significantly increase liquidity provision after the Rule. As for individual hedge fund styles, we find that Long/Short Equities and Fixed Income funds connected to LCFIs though prime brokerage relation marginally increase their liquidity provision to liquid stocks, while Others funds reduce it. In addition, Event Driven funds increase their liquidity provision to illiquid stocks (Table B6 and B7).

Overall, our results conform with our working assumption that hedge funds with other business connections to LCFIs are likely to receive direct investments from these institutions and are significantly impacted by the Rule. Prime brokerage activities are not directly affected by the Volcker Rule. Thus, the prime brokerage link between LCFIs and hedge funds does not generally alter the impact of the Volcker Rule on these funds.

[Tables B1 to B7 in here]

Table B1: The Volcker Rule and hedge funds market liquidity exposure by fund characteristics: prime brokerage relations

This table reports the impact of the Volcker Rule on hedge funds' exposure to market liquidity risk after controlling for fund characteristics. *LIQ* represents the Pástor and Stambaugh (2003) market liquidity factor, $Volcker$ is a dummy variable that equals 1 after April 2014 and *Prime* is a dummy variable that equals 1 if a US-based LCFI is a prime broker of a hedge fund. X indicates hedge fund characteristics: $Weak$ equals 1 for funds with returns below the median in each hedge fund category; *Lever* equals 1 if a fund uses leverage; $Young$ equals 1 if a fund's age is below the median across all live funds; *Small* equals 1 if a fund's assets under management are below the median; *Lock* equals 1 for funds with lock-up periods; *LowRed* equals 1 for funds with a total redemption period. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
$X =$	Weak	Lever	Young	Small	Lock	LowRed
LIQ (γ_0)	6.587***	6.354***	4.946***	6.489***	4.706**	5.214***
	(0.447)	(0.498)	(1.778)	(0.439)	(1.956)	(0.315)
LIQ·Volcker (γ_1)	-12.080***	-8.153***	-6.735***	-7.306***	-6.783***	-6.837***
	(0.726)	(0.766)	(1.797)	(0.713)	(1.839)	(0.487)
LIQ·Prime (γ_2)	0.484	1.518**	1.805	0.527	1.873	1.395**
	(0.574)	(0.755)	(1.687)	(0.577)	(1.811)	(0.691)
LIQ·Volcker·Prime (γ_3)	-0.142	-0.325	-0.069	-0.515	-0.410	-0.547
	(1.359)	(1.475)	(2.085)	(1.048)	(2.048)	(1.290)
X (δ)	0.011	0.116*	0.349***	0.513**	-0.047	-0.135**
	(0.072)	(0.062)	(0.054)	(0.226)	(0.065)	(0.056)
LIQ·X (η_0)	-4.323	-2.940	-0.283	-5.458	-0.017	-0.904
	(3.395)	(2.429)	(1.460)	(4.327)	(2.001)	(3.149)
LIQ·Volcker·X (η_1)	12.784***	3.162	1.486	3.439	1.539	1.111
	(2.954)	(2.223)	(1.618)	(3.537)	(1.884)	(3.147)
LIQ·Prime·X (η_2)	3.618	0.872	0.725	4.811	0.730	1.276
	(3.442)	(2.615)	(2.147)	(4.420)	(2.269)	(3.200)
LIQ·Volcker·Prime·X (η_3)	-3.386	-2.195	-3.204	-3.310	-4.287	-2.932
	(3.904)	(3.086)	(2.734)	(4.828)	(2.941)	(3.575)
Constant	0.634***	0.537***	0.534***	0.469***	0.610***	0.692***
	(0.012)	(0.024)	(0.033)	(0.053)	(0.061)	(0.037)
R-squared	0.003	0.003	0.003	0.003	0.003	0.003
Number of HFs	8,655	8,655	8,655	8,655	8,655	8,655
Fund fixed effect	Yes	No	Yes	Yes	No	Yes
Fung and Hsieh 7 factors	Yes	Yes	Yes	Yes	Yes	Yes

Table B2: The Volcker Rule and hedge funds' market liquidity risk exposure by investment style category: prime brokerage relations

This table compares the impact of the Volcker Rule on directional, non-directional and semi-directional funds' exposure to market liquidity risk. *LIQ* represents the Pástor and Stambaugh (2003) market liquidity factor. *Volcker* is a dummy variable that equals 1 after April 2014, *Prime* is a dummy variable that equals 1 if a US-based LCFI is a prime broker of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Directional	(2) Non-directional	(3) Semi-directional
LIQ (γ_0)	6.271***	4.522***	3.769
	(0.422)	(0.850)	(2.747)
LIQ·Volcker (γ_1)	-14.677***	-4.784***	-4.112
	(1.130)	(1.706)	(2.654)
LIQ·Prime (γ_2)	-1.402	-0.058	3.404
	(1.390)	(1.638)	(2.416)
LIQ·Volcker·Prime (γ_3)	1.015	0.700	-3.195
	(2.494)	(2.174)	(2.600)
MKT	1.868***	1.065**	-2.269
	(0.359)	(0.429)	(3.171)
SMB	-0.105	-0.085	-1.315
	(0.631)	(0.930)	(0.854)
TERM	-1.355***	0.411	-0.704
	(0.105)	(1.473)	(0.489)
CREDIT	-2.532***	-0.758	-5.141***
	(0.198)	(2.877)	(1.031)
PTFSBD	-0.706***	-2.291***	-1.712***
	(0.174)	(0.543)	(0.450)
PTFSFX	2.457***	0.864	1.200***
	(0.132)	(0.636)	(0.177)
PTFSCOM	1.298***	-0.773**	-0.912***
	(0.170)	(0.317)	(0.185)
Constant	0.601***	0.498***	0.699***
	(0.005)	(0.008)	(0.037)
R-squared	0.016	0.001	0.003
Number of HFs	1,922	1,380	4,703
Fund fixed effect	Yes	Yes	Yes

Table B3: The Volcker Rule and hedge funds' market liquidity exposure by investment strategy: prime brokerage relations

This table reports the impact of the Volcker Rule on hedge funds' exposure to market liquidity risk by different investment strategies. *LIQ* represents the Pástor and Stambaugh (2003) market liquidity factor, *Volcker* is a dummy variable that equals 1 after April 2014, and *Prime* is a dummy variable that equals 1 if a US-based LCFI is a prime broker of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Long/Short Equities	(2) Emerging Markets	(3) Global Macro	(4) Managed Futures	(5) Fixed Income	(6) Equity Market Neutral	(7) Relative Value	(8) Event Driven	(9) Multi Strategy	(10) Others
LIQ (γ_0)	7.204***	13.811***	3.392***	4.988***	2.900***	6.693**	8.111***	5.297***	-6.461	10.337***
	(0.272)	(1.077)	(0.624)	(0.454)	(0.418)	(2.942)	(1.276)	(0.507)	(11.019)	(0.846)
LIQ·Volcker (γ_1)	-5.890***	-16.262***	-3.999***	-20.092***	-2.158***	-11.404	-6.999***	-5.096***	3.138	-5.655***
	(0.647)	(3.515)	(1.333)	(1.672)	(0.556)	(7.811)	(1.943)	(1.726)	(10.564)	(1.221)
LIQ·Prime (γ_2)	0.824	-2.994	3.018	-2.142	-1.827**	3.355	-4.486*	-0.553	10.829	0.471
	(0.645)	(3.241)	(2.684)	(1.403)	(0.841)	(5.343)	(2.641)	(1.445)	(9.703)	(2.626)
LIQ·Volcker·Prime (γ_3)	-1.924	7.870	-8.101**	3.750	4.421**	-9.182	4.150	-1.061	-7.905	2.479
	(1.654)	(5.296)	(3.710)	(3.615)	(2.235)	(6.130)	(3.602)	(3.737)	(9.423)	(4.091)
MKT	0.346	-0.997	0.430	2.987***	1.257***	2.575**	-0.325	5.087***	-10.233	-1.259*
	(0.249)	(0.995)	(0.583)	(0.497)	(0.443)	(1.226)	(0.715)	(0.507)	(10.951)	(0.742)
SMB	-0.422	10.362***	-1.099	-3.221***	1.419***	-2.734	-1.600	1.022*	-4.131	-3.644***
	(0.431)	(1.790)	(0.865)	(0.727)	(0.395)	(3.791)	(1.197)	(0.595)	(2.606)	(0.990)
TERM	-0.033	-1.039***	-1.047***	-1.588***	-1.456***	6.324	-0.681***	-0.589***	-2.345	-1.036***
	(0.058)	(0.231)	(0.186)	(0.144)	(0.152)	(6.478)	(0.210)	(0.104)	(1.756)	(0.136)
CREDIT	-4.493***	-8.171***	-1.762***	-0.935***	-3.739***	10.719	-5.870***	-4.498***	-6.661*	-7.550***
	(0.134)	(0.523)	(0.262)	(0.218)	(0.229)	(12.009)	(0.588)	(0.299)	(3.592)	(0.365)
PTFSBD	-2.385***	-5.217***	-1.295***	0.732***	-1.542***	-3.260*	-2.499***	-2.517***	0.067	-3.505***
	(0.090)	(0.379)	(0.242)	(0.243)	(0.122)	(1.777)	(0.317)	(0.169)	(1.603)	(0.242)
PTFSFX	1.236***	1.421***	2.132***	2.979***	0.145*	2.969	0.736***	0.513***	1.155**	1.778***
	(0.056)	(0.248)	(0.223)	(0.195)	(0.075)	(2.903)	(0.193)	(0.094)	(0.504)	(0.144)
PTFSCOM	-1.161***	-2.066***	0.155	2.982***	-0.994***	1.130	-2.166***	-1.410***	-0.157	-2.679***
	(0.083)	(0.370)	(0.182)	(0.244)	(0.105)	(1.411)	(0.267)	(0.148)	(0.562)	(0.178)
Constant	0.650***	0.612***	0.554***	0.642***	0.399***	0.767***	0.523***	0.577***	0.868***	0.533***
	(0.003)	(0.011)	(0.009)	(0.007)	(0.006)	(0.017)	(0.010)	(0.005)	(0.155)	(0.009)
R-squared	0.066	0.110	0.013	0.027	0.070	0.003	0.128	0.114	0.001	0.121
Number of HFs	2,910	317	567	1,008	852	254	274	459	1,364	681

Table B4: The Volcker Rule and hedge funds' liquidity provision by fund characteristics: prime brokerage relations

This table reports the impact of the Volcker Rule on hedge funds' liquidity provision after controlling for fund characteristics. Rlp^{Liquid} and $Rlp^{Illiquid}$ represent the returns from providing liquidity calculated based on the method proposed by Jylhä et al. (2014) for stocks with the Amihud illiquidity measure below and above the median respectively, $Volcker$ is a dummy variable that equals 1 after April 2014 and $Prime$ is a dummy variable that equals 1 if a US-based LCFI is a prime broker of a hedge fund. X indicates hedge fund characteristics: $Weak$ equals 1 for funds with returns below the median in each hedge fund category; $Lever$ equals 1 if a fund uses leverage; $Young$ equals 1 if a fund's age is below the median across all live funds; $Small$ equals 1 if a fund's assets under management are below the median; $Lock$ equals 1 for funds with lock-up periods; $LowRed$ equals 1 for funds with a total redemption period. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$Rlp =$			Rlp^{Liquid}						$Rlp^{Illiquid}$			
$X =$	Weak	Lever	Young	Small	Lock	LowRed	Weak	Lever	Young	Small	Lock	LowRed
Rlp (γ_0)	1.613	-8.490***	-5.292**	-9.465***	0.592	2.521	86.541***	82.628***	84.808***	82.798***	84.792***	88.406***
	(2.273)	(2.686)	(2.336)	(2.173)	(2.192)	(2.560)	(2.391)	(2.598)	(2.123)	(2.207)	(2.136)	(2.561)
Rlp·Volcker (γ_1)	66.967***	20.539**	-8.012	4.881	1.135	-0.758	-85.914***	-65.144***	-73.665***	-59.511***	-66.495***	-71.831***
	(9.093)	(8.432)	(9.238)	(7.377)	(6.918)	(7.320)	(5.415)	(5.809)	(6.211)	(4.945)	(4.842)	(5.064)
Rlp·Prime (γ_2)	-6.656	-2.801	0.669	5.118	-0.969	6.922	-13.972**	-6.793	-3.936	-6.200	-1.068	-14.281**
	(5.701)	(7.173)	(5.745)	(6.087)	(5.837)	(7.136)	(5.664)	(6.171)	(4.920)	(5.037)	(5.233)	(6.109)
Rlp·Volcker ·Prime (γ_3)	-41.735*	-32.254	-21.180	-32.100	-38.384*	-47.811**	-2.284	-2.649	3.855	-4.422	-13.233	5.046
	(24.109)	(23.235)	(26.562)	(20.006)	(19.651)	(20.486)	(15.599)	(15.375)	(16.751)	(12.785)	(13.038)	(13.366)
X (δ)	-0.099***	0.028**	0.333***	0.209***	-0.044***	-0.071*	-0.115***	0.014	0.403***	0.207***	-0.036**	-0.030
	(0.012)	(0.013)	(0.031)	(0.022)	(0.015)	(0.038)	(0.011)	(0.013)	(0.030)	(0.021)	(0.015)	(0.037)
Rlp·X (η_0)	-14.743***	10.212***	8.428**	20.151***	-16.241***	-13.376***	-10.571***	3.800	-2.239	1.591	-0.207	-11.858***
	(3.983)	(3.889)	(3.947)	(4.429)	(4.418)	(4.094)	(3.982)	(3.355)	(3.817)	(4.107)	(3.951)	(3.601)
Rlp·Volcker·X (η_1)	-120.767***	-26.370**	51.278***	-0.327	26.348*	20.087	53.075***	-6.166	21.211**	-22.357**	-8.406	7.597
	(14.941)	(12.099)	(12.431)	(13.358)	(14.516)	(14.418)	(8.672)	(8.038)	(8.323)	(8.986)	(9.722)	(9.117)
Rlp·Prime·X (η_2)	19.785*	5.544	-1.592	-17.621*	5.847	-15.647	20.973**	-0.820	-24.320**	-3.209	-25.018***	16.316*
	(10.317)	(10.053)	(11.793)	(10.549)	(11.579)	(10.736)	(10.638)	(8.801)	(11.709)	(10.285)	(9.461)	(9.127)
Rlp·Volcker·Prime ·X (η_3)	2.014	3.282	-34.833	-8.557	25.629	22.188	-0.713	10.137	12.327	12.427	61.245**	-7.109
	(40.322)	(33.050)	(35.272)	(42.695)	(36.226)	(39.249)	(23.743)	(22.653)	(25.619)	(25.633)	(26.084)	(26.298)
Constant	0.620***	0.530***	0.488***	0.518***	0.555***	0.616***	0.658***	0.571***	0.499***	0.551***	0.587***	0.632***
	(0.004)	(0.010)	(0.009)	(0.007)	(0.008)	(0.015)	(0.004)	(0.010)	(0.009)	(0.007)	(0.008)	(0.015)
R-squared	0.045	0.045	0.045	0.045	0.045	0.045	0.049	0.049	0.049	0.049	0.049	0.049
Number of HFs	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655
Fund fixed effect	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
Fung and Hsieh 7 factors	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table B5: The Volcker Rule and hedge funds' liquidity provision by investment style category: prime brokerage relations

This table compares the impact of the Volcker Rule on directional, non-directional and semi-directional funds' liquidity provision. Rlp^{Liquid} and $Rlp^{Illiquid}$ represent the returns from providing liquidity calculated based on the method proposed by Jylhä et al. (2014) for stocks with the Amihud illiquidity measure below and above the median respectively, $Volcker$ is a dummy variable that equals 1 after April 2014, $Prime$ is a dummy variable that equals 1 if a US-based LCFI is a prime broker of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

$Rlp =$	(1)	(2) Rlp^{Liquid}	(3)	(4)	(5) $Rlp^{Illiquid}$	(6)
	Directional	Non-directional	Semi-directional	Directional	Non-directional	Semi-directional
Rlp (γ_0)	24.920***	-15.282***	-9.576***	73.325***	43.315***	93.028***
	(4.342)	(3.700)	(2.482)	(4.702)	(4.491)	(2.422)
Rlp·Volcker (γ_1)	-29.862*	32.628***	-8.114	-128.410***	-19.800***	-60.827***
	(16.255)	(12.070)	(8.591)	(11.658)	(7.593)	(5.724)
Rlp·Prime (γ_2)	-15.360	-21.346	-11.631*	2.347	-6.768	-3.811
	(12.034)	(14.019)	(7.063)	(11.086)	(15.159)	(6.306)
Rlp·Volcker·Prime (γ_3)	-19.951	27.610	45.105**	-40.593	19.178	20.384
	(43.248)	(26.518)	(21.958)	(28.094)	(21.093)	(14.427)
MKT	1.039***	0.737***	0.391**	1.313***	0.905***	0.792***
	(0.296)	(0.282)	(0.155)	(0.295)	(0.283)	(0.153)
SMB	0.994**	1.349***	0.345	2.250***	1.729***	1.515***
	(0.505)	(0.315)	(0.236)	(0.510)	(0.325)	(0.238)
TERM	-1.325***	-0.975***	-0.036	-1.182***	-0.993***	0.028
	(0.086)	(0.086)	(0.035)	(0.085)	(0.086)	(0.034)
CREDIT	-2.444***	-3.617***	-3.749***	-2.645***	-3.812***	-4.112***
	(0.147)	(0.184)	(0.074)	(0.154)	(0.194)	(0.076)
PTFSBD	-0.551***	-1.581***	-1.923***	-0.403***	-1.559***	-1.828***
	(0.127)	(0.096)	(0.057)	(0.127)	(0.095)	(0.057)
PTFSFX	2.172***	0.243***	0.943***	2.381***	0.262***	1.077***
	(0.110)	(0.052)	(0.037)	(0.114)	(0.055)	(0.037)
PTFSCOM	1.190***	-1.078***	-1.022***	1.263***	-1.090***	-0.997***
	(0.137)	(0.079)	(0.049)	(0.139)	(0.080)	(0.050)
Constant	0.585***	0.437***	0.626***	0.622***	0.452***	0.657***
	(0.004)	(0.004)	(0.002)	(0.004)	(0.004)	(0.002)
R-squared	0.015	0.079	0.069	0.017	0.080	0.075
Number of HFs	1,922	1,380	4,703	1,922	1,380	4,703
Fund fixed effect	Yes	Yes	Yes	Yes	Yes	Yes

Table B6: The Volcker Rule and hedge funds' liquidity provision to liquid stocks by investment strategy: prime brokerage relations

This table reports the impact of the Volcker Rule on hedge funds' liquidity provision by different investment strategies. Rlp^{Liquid} represents the returns from providing liquidity calculated based on the method proposed by Jylhä et al. (2014) and using stocks with Amihud illiquidity measure below the median, $Volcker$ is a dummy variable that equals 1 after April 2014, and $Prime$ is a dummy variable that equals 1 if a US-based LCFI is a prime broker of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Long/Short Equities	(2) Emerging Markets	(3) Global Macro	(4) Managed Futures	(5) Fixed Income	(6) Equity Market Neutral	(7) Relative Value	(8) Event Driven	(9) Multi Strategy	(10) Others
Rlp^{Liquid} (γ_0)	-0.513	13.988	7.656	37.830***	-2.367	-19.234***	-25.211**	-27.232***	-14.468***	-25.424***
	(3.726)	(13.194)	(6.636)	(5.110)	(3.343)	(5.684)	(10.118)	(4.351)	(2.980)	(7.015)
Rlp^{Liquid} ·Volcker (γ_1)	-46.215***	-182.858***	12.691	-72.058***	16.050	-51.436	74.028**	-116.824***	49.500***	135.733***
	(11.734)	(66.781)	(22.042)	(22.064)	(11.687)	(41.350)	(30.043)	(35.007)	(12.490)	(21.031)
Rlp^{Liquid} ·Prime (γ_2)	-20.554**	-38.774	-24.149	30.465	-26.543**	3.897	4.637	-16.267	-1.176	41.439*
	(10.285)	(30.364)	(17.458)	(20.265)	(10.675)	(19.162)	(21.819)	(14.441)	(9.214)	(23.936)
Rlp^{Liquid}·Volcker ·Prime (γ_3)	87.134***	52.304	11.551	55.003	58.738**	-14.425	-53.037	140.615	-18.961	-109.889*
	(27.705)	(225.914)	(56.436)	(58.141)	(27.321)	(94.387)	(54.135)	(90.566)	(36.556)	(59.612)
MKT	-0.082	-2.646***	0.102	2.282***	0.888***	1.255***	-1.164*	4.490***	0.038	-2.850***
	(0.215)	(0.828)	(0.431)	(0.414)	(0.327)	(0.367)	(0.676)	(0.409)	(0.233)	(0.558)
SMB	0.422	11.480***	0.028	-1.795***	1.544***	0.966	-0.454	1.984***	-0.423	-2.220***
	(0.343)	(1.555)	(0.626)	(0.564)	(0.307)	(0.622)	(0.942)	(0.417)	(0.327)	(0.841)
TERM	0.112**	-0.842***	-0.913***	-1.706***	-1.111***	-0.135	-0.258	-0.260***	-0.381***	-0.680***
	(0.049)	(0.176)	(0.146)	(0.118)	(0.093)	(0.105)	(0.176)	(0.070)	(0.057)	(0.124)
CREDIT	-4.215***	-7.854***	-1.695***	-1.130***	-3.175***	-1.077***	-5.045***	-3.778***	-2.620***	-6.788***
	(0.104)	(0.407)	(0.198)	(0.149)	(0.151)	(0.173)	(0.466)	(0.184)	(0.111)	(0.274)
PTFSBD	-2.150***	-4.195***	-1.069***	0.587***	-1.453***	-0.842***	-2.462***	-2.144***	-1.383***	-3.304***
	(0.079)	(0.283)	(0.181)	(0.173)	(0.095)	(0.154)	(0.304)	(0.136)	(0.093)	(0.213)
PTFSFX	1.128***	1.086***	1.783***	2.728***	0.243***	0.228**	0.715***	0.572***	0.612***	1.610***
	(0.050)	(0.205)	(0.157)	(0.167)	(0.054)	(0.093)	(0.159)	(0.075)	(0.063)	(0.124)
PTFSCOM	-1.109***	-1.721***	0.175	2.557***	-0.931***	0.001	-1.976***	-1.288***	-0.666***	-2.503***
	(0.068)	(0.285)	(0.134)	(0.200)	(0.066)	(0.140)	(0.226)	(0.122)	(0.074)	(0.139)
Constant	0.645***	0.612***	0.547***	0.602***	0.423***	0.457***	0.553***	0.592***	0.598***	0.564***
	(0.003)	(0.009)	(0.006)	(0.006)	(0.004)	(0.005)	(0.009)	(0.004)	(0.003)	(0.007)
R-squared	0.067	0.114	0.013	0.032	0.096	0.020	0.110	0.126	0.056	0.127
Number of HFs	2,910	317	567	1,008	852	254	274	459	1,364	681

Table B7: The Volcker Rule and hedge funds' liquidity provision to illiquid stocks by investment strategy: prime brokerage relations

This table reports the impact of the Volcker Rule on hedge funds' liquidity provision by different investment strategies. $Rlp^{Illiquid}$ represents the returns from providing liquidity calculated based on the method proposed by Jylhä et al. (2014) and using stocks with Amihud illiquidity measure above the median, $Volcker$ is a dummy variable that equals 1 after April 2014, and $Prime$ is a dummy variable that equals 1 if a US-based LCFI is a prime broker of a hedge fund. MKT, SMB, TERM, CREDIT, PTFSBD, PTFSFX, and PTFSCOM are the Fung and Hsieh 7 factors. Standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Long/Short Equities	(2) Emerging Markets	(3) Global Macro	(4) Managed Futures	(5) Fixed Income	(6) Equity Market Neutral	(7) Relative Value	(8) Event Driven	(9) Multi Strategy	(10) Others
$Rlp^{Iliquid}$ (γ_0)	102.167***	153.783***	45.349***	64.533***	26.466***	32.439***	83.253***	60.229***	71.027***	136.090***
	(3.511)	(12.299)	(7.497)	(5.724)	(3.755)	(6.236)	(13.502)	(4.847)	(3.902)	(8.513)
$Rlp^{Iliquid}$ ·Volcker (γ_1)	-45.854***	-190.688***	-42.067***	-177.543***	-21.338***	-29.497	-34.590	-129.804***	-61.850***	-41.045***
	(8.288)	(42.832)	(14.922)	(16.546)	(6.825)	(25.525)	(22.834)	(21.563)	(7.745)	(14.384)
$Rlp^{Iliquid}$ ·Prime (γ_2)	6.593	57.723**	-4.644	-5.279	-4.668	4.864	-36.374	2.410	-28.476***	-9.877
	(8.822)	(25.402)	(16.555)	(16.515)	(14.015)	(18.184)	(22.714)	(17.559)	(9.353)	(16.871)
$Rlp^{Iliquid}$·Volcker ·Prime (γ_3)	5.734	-179.104	-2.431	-44.546	21.984	68.613	44.269	81.875**	22.531	-7.238
	(19.166)	(122.198)	(36.351)	(37.888)	(18.431)	(54.661)	(39.046)	(38.402)	(24.474)	(37.963)
MKT	0.431**	-2.070***	0.353	2.449***	0.859***	1.276***	-0.727	4.538***	0.302	-1.990***
	(0.212)	(0.795)	(0.431)	(0.421)	(0.294)	(0.380)	(0.669)	(0.416)	(0.230)	(0.538)
SMB	1.803***	13.853***	0.569	-0.382	1.662***	1.374**	0.145	2.667***	0.341	-0.977
	(0.348)	(1.550)	(0.618)	(0.563)	(0.293)	(0.625)	(0.937)	(0.422)	(0.325)	(0.843)
TERM	0.213***	-0.583***	-0.861***	-1.523***	-0.979***	-0.152	-0.282*	-0.273***	-0.359***	-0.623***
	(0.048)	(0.179)	(0.143)	(0.116)	(0.082)	(0.106)	(0.170)	(0.068)	(0.056)	(0.120)
CREDIT	-4.566***	-8.417***	-1.842***	-1.252***	-2.907***	-1.261***	-5.408***	-4.059***	-2.953***	-7.357***
	(0.107)	(0.409)	(0.206)	(0.156)	(0.128)	(0.180)	(0.499)	(0.187)	(0.121)	(0.291)
PTFSBD	-2.043***	-3.941***	-1.002***	0.764***	-1.404***	-0.835***	-2.396***	-2.117***	-1.307***	-3.158***
	(0.078)	(0.280)	(0.179)	(0.174)	(0.087)	(0.155)	(0.297)	(0.134)	(0.092)	(0.210)
PTFSFX	1.259***	1.460***	1.874***	2.984***	0.291***	0.257***	0.781***	0.617***	0.777***	1.790***
	(0.051)	(0.217)	(0.163)	(0.172)	(0.053)	(0.096)	(0.170)	(0.075)	(0.065)	(0.130)
PTFSCOM	-1.073***	-1.502***	0.168	2.668***	-0.862***	0.044	-2.043***	-1.188***	-0.682***	-2.606***
	(0.070)	(0.291)	(0.138)	(0.204)	(0.060)	(0.136)	(0.232)	(0.123)	(0.075)	(0.145)
Constant	0.669***	0.659***	0.571***	0.642***	0.449***	0.460***	0.592***	0.596***	0.644***	0.638***
	(0.003)	(0.011)	(0.007)	(0.006)	(0.004)	(0.005)	(0.011)	(0.004)	(0.004)	(0.008)
R-squared	0.074	0.122	0.015	0.033	0.098	0.022	0.113	0.129	0.060	0.134
Number of HFs	2,910	317	567	1,008	852	254	274	459	1,364	681