

HEDGE FUNDS, FINANCIAL INTERMEDIATION, AND SYSTEMIC RISK

- An important channel through which largely unregulated hedge funds interact with regulated institutions is prime brokerage relationships.
- Central to these relationships is the extension of credit to hedge funds, which exposes banks to counterparty credit risk.
- Counterparty credit risk management (CCRM) practices, used to assess credit risk and limit counterparty exposure, are banks' first line of defense against market disruptions with potential systemic consequences.
- Hedge funds' unrestricted trading strategies, liberal use of leverage, opacity to outsiders, and convex compensation structure make CCRM more difficult, as they exacerbate potential market failures.
- While past market failures suggest that CCRM is not perfect, it remains the best initial safeguard against systemic risk; thus, the current emphasis on CCRM as the primary check on hedge fund risk-taking is appropriate.

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1. INTRODUCTION

Financial economists and policymakers have historically focused on banks as prospective channels of systemic distress through, for instance, bank runs and the concomitant reduction in the supply of credit. This “special” attribute of banks has been behind the classic policy rationale for regulating them. The ongoing move toward financial markets, arm’s-length transactions, and active trading, however, has shifted focus to the potential impact of a hedge-fund-led disruption on financial institutions, markets, and the broader economy.¹

Financial intermediaries, of course, have many ways to reduce their exposure and mitigate the impact of financial market shocks. The first line of defense is the intermediary’s counterparty credit risk management (CCRM) system. Banks establish limits; implement risk reporting infrastructures; and define haircut, margining, and collateral policies—all designed to assess credit risk and limit their counterparty exposure. Effective CCRM is obviously needed for any counterparty, but hedge funds differ in important ways, such as in their use of

¹See, for example, McCarthy (2006), President’s Working Group on Financial Markets (2007), and the papers in the Banque de France (2007) special issue devoted to hedge funds. In addition to concerns about financial system implications, there are concerns about investor protection and market integrity issues, which we do not discuss.

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complex trading strategies and instruments, leverage, opacity, and convex compensation structures, all of which increase the challenges to effective CCRM.

This article examines how the nature and characteristics of hedge funds may generate “market failures” that make CCRM for exposures to hedge funds intrinsically more difficult to manage, both for the individual firm and for policymakers concerned with systemic risk. We put forward no specific new policy proposals, however, because we believe CCRM remains the appropriate starting point for limiting the potential for hedge funds to generate systemic disruptions.² By laying out the issues and highlighting the specific linkages from hedge funds to systemic risk, we hope to highlight areas for further research on when and how markets may fail to yield a desirable outcome.

2. HEDGE FUNDS 101

We begin by describing the difference between a hedge fund and other asset management vehicles such as mutual or pension funds, then discuss the traditional role of counterparty credit risk management, and present some stylized facts about the hedge fund industry.

2.1 What Is a Hedge Fund?

Hedge funds, in short, are largely unregulated, private pools of capital. Hedge fund managers can invest in a broad array of assets and pursue many investment strategies, such as global macro, market neutral equity, convertible arbitrage, or event-driven.³ While strategies and individual hedge funds are quite heterogeneous, it is useful to focus on four broad characteristics that distinguish hedge funds from other types of money management funds.

First, hedge funds are not restricted by the type of trading strategies and financial instruments they may use. In particular, hedge funds can and do make use of short-selling, derivatives, and options, all of which are complex and potentially nonlinear in payoffs. Second, hedge funds make liberal use of leverage, be it directly through the use of debt or indirectly through leverage embedded in derivatives. This freedom is possible because

²Supervisors, of course, have other tools such as direct regulation or disclosure requirements that may mitigate the potential for systemic disruptions. We discuss these in Section 5.

³See the useful overviews by Fung and Hsieh (1999), McCarthy (2006), Hildebrand (2007), and Stulz (2007).

hedge funds in the United States largely fall outside of the regulatory umbrella by virtue of being open only to accredited investors and large institutions.⁴ Of course, hedge fund investors and counterparties impose some discipline on the amount of leverage actually employed. This discipline,

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however, may be limited by the third key characteristic—opacity to outsiders—which again is in large part due to the funds’ unregulated nature. Finally, hedge fund managers are typically compensated based on both scale and absolute performance through a dual fee structure, for example, the “2-and-20” set-up whereby managers retain 2 percent of the net asset value of the fund and 20 percent of returns in excess of some benchmark.

The first two strategies—the use of complex, nonlinear financial instruments and the use of leverage—make hedge funds somewhat unusual in the asset management world, but not unique among financial intermediaries.⁵ Mutual funds, for example, have a limited ability to short-sell.⁶ In contrast, both of these strategies are available to commercial and investment banks, and many have proprietary trading units that emulate hedge fund investment strategies. This is important, as those firms often act as counterparties to hedge funds and likely have experience with a range of financial instruments and strategies, and should therefore be able to adjust their risk management practices accordingly. It is precisely this flexibility, however, that allows hedge funds to play their critical role in terms of price discovery, arbitrage, and increased market efficiency.

Opacity also is not unique to hedge funds as financial institutions generally, and banks especially are thought to be more opaque than firms in other industries.⁷ Financial firms, however, often have traded instruments such as equity shares or bonds outstanding, so they are subjected to further scrutiny by

⁴The regulatory scope of the Securities and Exchange Commission is restricted to protecting small, retail investors. The term “accredited investor” helps define what is in and out of scope. See <<http://www.sec.gov/answers/accred.htm>>.

⁵There are other investment vehicles that make use of some of these strategies, such as private equity and vulture funds.

⁶See Almazan et al. (2004) for a description of the regulations that govern how mutual funds may behave in terms of issuing shares, distributing dividends, and reporting, as well as investment restrictions such as the use of leverage and short-selling.

⁷Morgan (2002) shows that rating agencies disagree more about financial firms than about nonfinancials, a sign of opacity, although Flannery, Kwan, and Nimalendran (2004) present an opposing view.

market participants. In contrast, hedge funds, due to their unregulated and private nature, are not subject to such wide scrutiny unless they choose to issue public securities. Moreover, the success of a hedge fund often depends on proprietary trading strategies that, if made public, can be used by others to trade against them. Investors know this and are thus willing to tolerate a degree of opacity not seen in the mutual fund industry in the hope of securing particularly rich returns.⁸

Finally, the compensation structure of hedge funds differs markedly from that of other institutional investors such as mutual funds. In particular, hedge fund traders and managers tend to be compensated more on absolute return and scale, while their brethren in institutional investing typically have their compensation tied to performance relative to some benchmark such as the S&P 500.⁹ Hedge fund managers also have added optionality in the form of hurdle rates (no incentive fee if returns are below the hurdle rate) and high-water marks (incentive fees only on new profits, that is, after past losses are made up), making payoffs potentially very convex and therefore asymmetric: gains and losses are treated differently (Ackermann, McEnally, and Ravenscraft 1999).¹⁰ This convex

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payoff structure provides strong incentives for hedge fund managers to take on risk and leverage. Although incentive fees also play an important role in the mutual fund industry, they are required by law to be symmetric in the United States (Elton, Gruber, and Blake 2003).

The combination of opacity and highly convex compensation structures has the potential to create excess risk-taking, which may make investors reluctant to commit capital. As a result,

⁸This increased managerial discretion does result in higher risk-adjusted returns, as found by Agarwal, Daniel, and Naik (2007).

⁹Relative returns do matter to the extent that capital flows toward better performing hedge funds. That is, high-water marks compensate absolute returns only to the extent that capital under management is fixed. As we discuss later, hedge fund capital does have some mobility.

¹⁰Agarwal, Daniel, and Naik (2007) report that more than 60 percent of funds have hurdle rates and more than 80 percent have high-water-mark provisions. Note that these authors find that funds with high-water marks earn higher returns—about 20 percent higher—as they should, but hurdle rates have no effect on fund performance.

investors prefer hedge fund managers with a significant fraction of their personal wealth invested in the fund, that is, “skin in the game,” but information on manager stakes is difficult to come by and is generally known only to the largest and most sophisticated investors. Consequently, a hedge fund’s ability to raise and retain capital may be particularly acute in periods of stress, when investors may try to withdraw capital from hedge funds.

To be sure, these characteristics are relevant for many types of financial firms, such as the proprietary trading desks at regulated financial institutions. Hedge funds are arguably different in degree but not in kind; thus, any preventive measures or policy discussions should not be limited to hedge funds alone. We now turn to traditional tools used to reduce exposure.

2.2 Counterparty Credit Risk Management

Hedge funds interact with regulated financial institutions and intermediaries in many ways, including prime brokerage relationships, where regulated intermediaries provide services such as trading and execution, clearance and custody, securities lending, technology, and financing through margin loans and repurchase agreements.¹¹ An important part of these relationships is the extension of credit to the hedge fund, so the financial institution is exposed to counterparty credit risk. As a result, traditional CCRM systems are the first line of defense between unregulated hedge funds and regulated financial institutions.

An integral part of CCRM is margining and collateral practices, which are designed to reduce counterparty credit risk in leveraged trading by providing a buffer against increased exposure to the dealer providing the financing or derivatives contract. In general, a financial institution may be willing to extend credit to the hedge fund against the posting of specific collateral that is valued at no less than the amount of the exposure. This reduction in settlement risk in leveraged trading increases confidence and thereby promotes active financing of leveraged trading.

To be precise, variation margin is the amount of collateral or cash provided to a dealer to cover past changes in the value of the prices move and evolve, for example, the mark-to-market of the position may deteriorate and trigger a margin call. Initial margin, in contrast, is an additional amount of collateral designed to cover potential future changes in the value of the contract (potential future exposure). Variation margin and

¹¹Revenues for prime brokerage services alone accounted for about \$8 billion in 2005, with total hedge-fund-related business revenue estimated at \$26 billion, about 2 percent of the funds’ total assets under management (Richard Beales and Joana Chung, “Banks Take to a Supporting Role as Hedge Funds Flourish,” *Financial Times*, August 9, 2006, p. 7).

Box 1

Determination of Initial Margins

Consider the initial margin standards of exchanges such as the Chicago Mercantile Exchange or the Chicago Board of Trade. Specifically, the March 12, 2007, initial margin requirement for a JPY/USD futures contract is \$1,350.^a These contracts are sold in units of ¥12,500,000 each. On March 12, 2007, the exchange rate was \$1 = ¥116. The annual volatility for this exchange rate is measured to be about 8.4 percent. Then, one-day 99 percent VaR turns out to be very close to the initial margin requirement:

$$VaR = 2.33 \times \left(\frac{8.4\%}{\sqrt{252}} \right) \times \left(\frac{12,500,000}{116} \right) = \$ 1300 ,$$

where the annual volatility is converted to a daily volatility using the standard approach of normalizing by (the square root of) the number of trading days in a year. This exercise makes clear that risk-based initial margin requirements depend on market conditions, here the exchange rate and its volatility. If market conditions worsen, the initial margin would be too low and additional margin would be called for.

The level of initial margin can be more sensitive to volatility and market conditions in over-the-counter (OTC) markets, where trading terms are more flexible than on futures exchanges. Nevertheless, even in OTC markets, margin locks are being adopted to provide more predictability of initial margin requirements. In a margin-lock, a dealer will commit to freeze the initial margin terms (for example, the volatility term in the formula above) for a specified time period, say, three months. This practice reduces the liquidity risk for the trading counterparty—though at the cost to the dealer of having fixed initial margin terms at a time when the volatility of exposures may be rising. Note, however, that margin locks do not preclude the dealer from collecting variation or maintenance margins.

^aThis example is adapted from Jorion (2007). Margin information for the Chicago Mercantile Exchange can be found at <<http://www.cme.com/html.wrap/wrappedpages/clearing/pbrates/PBISHomePage.htm>>.

initial margin together ensure that collateral held by the dealer is sufficient to cover the current replacement value of the contract if the counterparty defaults, and also the potential change in value of the contract between the time of the default and the time at which the trading position can be liquidated. Initial margins vary by financial instrument and are usually set to cover changes in the contract's value up to a certain

probability, typically 95 percent to 99 percent, over a particular horizon, typically one day to two weeks (see Box 1).

Other forms of traditional CCRM include the development of a broad set of risk metrics including internal ratings; ongoing monitoring and evaluation of exposures such as stress testing on a consolidated basis over a range of suitably stressful scenarios; due diligence to understand the strategies and history of the counterparty; limits on specific trades, exposures, or concentrations; and well-defined processing arrangements and settlement protocols. All of these help control exposure and reduce the risk of the financial institution dealing with a hedge fund counterparty.

Our discussion so far has focused on the CCRM imposed by the financial intermediaries that interact directly with a counterparty such as a hedge fund. Of course, investors also play a critical role in disciplining hedge fund behavior and reducing excess risk-taking. It is clearly in the interest of individual investors to understand and evaluate the objectives, strategies, fee structures, and history of the particular funds in which they invest, but the same factors that make CCRM difficult also increase the challenges associated with investor market discipline.

A recent industry study, however, reported improvements in risk management practices in the global hedge fund industry and noted in particular that 87 percent of dealers surveyed were actively negotiating credit terms specifically to increase transparency and disclosure.¹² Moreover, the invested capital of the hedge fund managers and the managers' desire to maintain the franchise value of the fund also provide clear incentives to improve risk management.

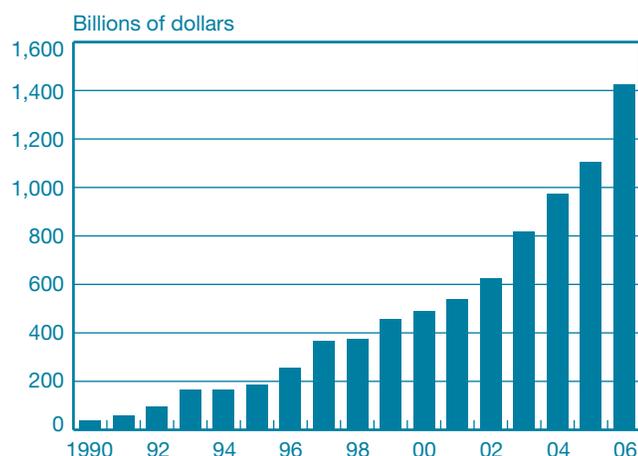
2.3 Industry Overview

By the end of 2006, the global hedge fund industry had about \$1.43 trillion in assets¹³ under management spread across more than 11,000 funds, one-third of which are fund of funds (European Central Bank 2006). However, because hedge funds are not required to register with any financial regulator or supervisor, these numbers can only be estimated. As we illustrate in the chart, the industry has grown enormously: in 1990, hedge funds had less than \$400 billion in assets under management, and the \$1 trillion mark was passed in 2005. Moreover, hedge funds are grabbing an increasing share of investable assets compared with mutual funds: in 1993, hedge fund assets under management were less than 4 percent of

¹²Mercer Oliver Wyman (2006); the sample of broker-dealers constituted 90 percent of the global business banks do with hedge funds.

¹³Source: Hedge Fund Research, Inc.

Total Assets under Global Management of Hedge Funds



Source: Hedge Fund Research, Inc.

mutual fund assets; that share increased to more than 10 percent by 2005 (Stulz 2007).

Hedge funds are also dominant players in several markets: in 2005, by one estimate, they accounted for 89 percent of U.S. trading volume in convertible bonds, 66 percent of volume in distressed debt, 33 percent of volume in emerging market bonds and in leveraged loans, 20 percent of speculative-grade-bond volume, and 38 percent of credit derivatives volume.¹⁴ By early 2006, their estimated share of credit derivatives trading had increased to 58 percent (Greenwich Associates 2006). As these figures suggest, hedge funds are now engaged in a broader range of activity than in the past, especially in the trading of credit instruments.

Hedge funds come and go. Estimates of hedge fund survival rates vary between 85 percent and 95 percent (an attrition rate of 5 percent to 15 percent) per year, depending on the year and the style of fund. In their literature review, Chan et al. (2006) report that 30 percent of funds do not make it past three years, and 40 percent of funds do not survive past the fifth year. These survival rates are much lower than in the mutual fund industry, where average one-year attrition is less than 4 percent (Carhart et al. 2002). Although attrition rates are high for hedge funds, death by undercapitalization does not seem to be the main reason. Gupta and Liang (2005) report that nearly 90 percent of dead funds in their study were adequately capitalized at the time of closure.

¹⁴Source: Henny Sender and Anita Raghavan, "Private Money: The New Financial Order," *Wall Street Journal*, July 27, 2006, p. A1.

3. SYSTEMIC RISK

3.1 Defining Systemic Risk

Amid the rapid growth and innovation in global capital markets, financial stability and systemic risk have emerged as top policy concerns around the world. The Reserve Bank of Australia, the Bank of England, the Bank of Japan, the Norwegian Norges Bank, the Bank of Spain, the Swedish Riksbank, the Swiss National Bank, the Financial Stability Forum, the European Central Bank, and the International Monetary Fund, to name a few, publish regular reports on global financial conditions and financial stability issues.

Systemic risk, however, is not always defined and remains somewhat nebulous, so it is useful to be precise about what we mean by the term. In their exhaustive survey, DeBandt and Hartmann (2002) describe a "systemic crisis" as occurring when a shock affects:

"a considerable number of financial institutions or markets in a strong sense, thereby severely impairing the general well-functioning (of an important part) of the financial system. The well-functioning of the financial system relates to the effectiveness and efficiency with which savings are channeled into the real investments promising the highest returns" (p. 11).

They define "systemic risk" as the risk of experiencing a systemic event.

Bordo, Mizrach, and Schwartz (1998) offer a similar description of a systemic event as a situation where:

"shocks to one part of the financial system lead to shocks elsewhere, in turn impinging on the stability of the real economy" (p. 31),

while the Counterparty Risk Management Policy Group II (2005) describes a financial shock with systemic consequences as one with:

"major damage to the financial system *and* the real economy" (p. 5, emphasis in original).

In our view, an essential feature of systemic risk is the potential of financial shocks to lead to substantial, adverse effects on the *real* economy, for example, by causing a reduction in productive investment by reducing credit provision or destabilizing economic activity. Indeed, it is the transmission of financial events to the real economy that is the defining feature of a systemic crisis, and what distinguishes it

from a purely financial event.¹⁵ As we discuss in more detail below, these real effects might occur if credit provision is interrupted through shocks to the banking sector or through capital market disruptions.

This view also seems to reflect the thinking around the intervention during the collapse of Long-Term Capital Management (LTCM) in the fall of 1998. Federal Reserve Bank of New York President William J. McDonough (1998), in congressional testimony after the LTCM collapse, stated:

“there was a likelihood that a number of credit and interest rate markets would experience extreme price moves and possibly cease to function for a period of one or more days and maybe longer . . . Most importantly, this would have led to further increases in the cost of capital to American businesses.”

Presumably, the increase in the cost of capital would have led to a reduction in credit provision and real activity would have suffered. McDonough’s testimony explicitly stated that financial losses associated with asset price declines or failed trading strategies were not enough to motivate an intervention; rather, the concern was for “other market participants—investors who

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had no dealings with Long-Term Capital.” This type of impact, either through direct exposures of particular intermediaries or broader disruptions to financial markets, provides a useful framework for discussing systemic risk as an “externality,” which is a classic rationale for government intervention.

An important point is that the optimal level of systemic risk is not zero. A regulator, in principle, could eliminate all systemic risk by imposing sufficiently stringent limits on leverage or balance sheet linkages, or by imposing severe operating restrictions on key financial intermediaries, but this would unduly curtail the efficient activities of the financial sector and would be suboptimal from a social perspective. Without a fully developed model of the benefits of financial markets and the costs (and origins) of systemic risk, we obviously cannot determine the optimal level of systemic risk here, but it

¹⁵Bordo, Mizrahi, and Schwartz (1998) label events that only lead to asset price declines and wealth losses without impinging the real economy as “pseudo-systemic risk” and conclude that “wealth losses are not synonymous with real systemic risk” (p. 33). The Counterparty Risk Management Policy Group II (2005) makes a similar distinction between a financial “disturbance” and a financial “shock,” where only the latter has broad effects on the real economy.

should be stressed that concern should focus on “inefficient” systemic risk that exceeds the socially optimal level.¹⁶ As we discuss below, the idea of inefficient systemic risk is closely linked to market failures in counterparty credit risk management.

3.2 The Real Effects of Financial Intermediation

If a meaningful definition of systemic crisis involves a potential impact on real economic outcomes, the next step is to identify precisely the linkages between the financial sector in general, and hedge funds more specifically, and the real economy. This connection has historically been made through the “special” role that financial intermediaries, particularly banks, play in resolving information problems in the provision of credit. We begin with a discussion of this channel, and then broaden our perspective to consider the role of hedge funds as a potential source of systemic risk.

The traditional explanation for why banks matter for real economic activity rests on the assumption that borrowers (firms and entrepreneurs) are risky, but banks have unique skills that allow them to effectively screen lending opportunities, ex ante before investing, and then to monitor borrowers ex post. As it is inefficient for each saver to do this individually, banks become the “delegated monitors” that produce the critical information to facilitate the efficient allocation of credit. If bank lending

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activity becomes disrupted, due to insolvency or capital shocks, for example, socially productive relationships are severed and critical information is destroyed. As a result, some viable investment projects go unfunded and economic activity is reduced; ample evidence shows that bank lending affects real

¹⁶A simple model with diminishing marginal returns to financial intermediation and increasing marginal costs, for example, generates an optimal level of systemic risk that is not zero.

outcomes.¹⁷ Note that this type of pure information problem tends to reduce the supply of credit (credit rationing). Later, we discuss how agency problems may reverse this and generate excess risk-taking.

Bank lending, however, is not the only information-intensive form of credit provision, and other forms are rising in relative importance. According to the Federal Reserve's Flow of Funds Accounts of the United States, bank credit accounted for 39 percent of outstanding credit market instruments for nonfarm, nonfinancial corporations in 2005, down from 52 percent in 1985, which reflects the growing importance of alternative sources of credit such as corporate bonds and commercial paper. These capital market instruments also rely on specific knowledge about borrowers' creditworthiness, so a financial disruption in these markets could also limit the provision of credit and have real economic effects.¹⁸

Financial intermediaries in this environment may not fund as much credit directly on their balance sheet, but act as underwriters, originators, and distributors of credit, and also as traders in the secondary market. Hedge funds, in particular, are active traders and contribute to increased market efficiency and liquidity through their frequent trading and ability to exploit arbitrage opportunities. This activity is generally stabilizing and provides considerable benefits in terms of greater market liquidity, lower volatility, and more stable relationships in the relative prices of financial assets. This should promote an efficient allocation of capital and improve real outcomes.

3.3 Hedge Funds and Systemic Risk

How, then, might hedge funds generate systemic risk? If systemic risk is fundamentally about financial market linkages to the real economy, then hedge funds create systemic risk to the extent that they can disrupt the ability of financial intermediaries or financial markets to efficiently provide credit. The President's Working Group on Financial Markets (1999), for instance, identifies the potential for the liquidation of a highly leveraged institution to lead to volatility and sharp asset price declines that "heighten uncertainty about credit risk and disrupt the intermediation of credit . . . heighten the risk of a contraction in

¹⁷Ashcraft (2005) shows that the FDIC-induced failure of healthy banks in the 1980s led to persistent declines in relative income levels. A bank failure could also have real, adverse consequences if depositors are not made whole (their wealth is reduced) or if credit-constrained depositors lose liquidity, although deposit insurance and prompt resolution of failures limit these effects.

¹⁸Santos (2006) shows the importance of information as a determinant of access to the corporate bond market, especially during recessions, when signals of firm quality may be noisy.

real economic activity" (p. 23). A hedge fund link to the real economy might occur through banks' direct exposures to hedge funds, disruptions to capital markets that hinder credit provision or allocation, or indirect effects as bank problems feed back into the broader financial markets. We consider each point in turn and end with a discussion of what makes hedge funds particularly prone to exacerbating financial shocks.¹⁹

Commercial banks and securities firms are directly linked to hedge funds through their counterparty exposures, for example, short-run financing for leveraged positions, prime brokerage activity, and trading counterparty exposures in over-

If systemic risk is fundamentally about financial market linkages to the real economy, then hedge funds create systemic risk to the extent that they can disrupt the ability of financial intermediaries or financial markets to efficiently provide credit.

the-counter and other markets. If a bank has a large exposure to a hedge fund that defaults or operates in markets where prices are falling rapidly, the bank's greater exposure to risk may reduce its ability or willingness to extend credit to worthy borrowers. Collateralizing the credit exposures may not be enough to mitigate the risk. A sudden decline in asset prices triggered, for example, by the unwinding of a highly leveraged hedge fund can reduce the value of that collateral, or generate liquidity risk and further price declines via variation margining as investors sell into the falling market to meet margin calls. Such declines in collateral values, if sharp enough, can cast doubt on the assumptions relied upon in stress testing and risk management, and cause dealers to become more risk averse in their credit decisions (see Box 2). Moreover, according to the "financial accelerator" model popularized by Bernanke and Gertler (1989), a fall in asset values may reduce collateral values and thus hinder the ability of firms to borrow, which amplifies the impact of the initial shock.

To the extent that bank-dependent borrowers cannot access alternative sources of funding, investment and economic activity will be curtailed until new relationships are formed and information recreated. This mechanism parallels the concern

¹⁹See McCarthy (2006) and Hildebrand (2007) for discussions of the transmission mechanism from hedge funds to financial stability that focus on the direct link between an intermediary and a hedge fund counterparty.

Hedge Funds and Liquidity Risk

Hedge funds are typically viewed as being liquidity providers in the capital markets, which helps create market efficiency.^a

Recent reports, however, suggest that hedge funds are moving increasingly into less liquid markets, with structured credit and distressed debt at the top of the list (European Central Bank 2006; Chan et al. 2006). In the presence of leverage, the combination of relatively illiquid assets and short-term financing exposes the hedge fund to possibly significant liquidity risk.

Hedge funds themselves, of course, are well aware of the consequences of their moves into less liquid markets, as are their counterparties. Perhaps as a result, hedge funds are adopting longer lock-up periods on their investors' ability to withdraw funds, which gives fund managers added flexibility to ride out market fluctuations (European Central Bank 2006; Mercer Oliver Wyman 2006). Mercer Oliver Wyman also points out the increased use of gates and notice periods for investor redemption, as well as contractual changes on the part of broker-dealers to increase transparency on hedge funds' liquidity positions. All of these market mechanisms act to reduce liquidity risk for hedge funds.

Nonetheless, liquidity management remains an important concern because of the potential impact on market dynamics. Before discussing the concern, it is useful to be precise and distinguish two types of liquidity: "market liquidity" is the ability to trade without affecting market prices, while "funding liquidity" is the ability to acquire funding in the event of credit impairment or some other shock. While distinct, these types of liquidity interact in important ways. When funding liquidity is abundant, for example, traders are able to finance positions, trade in higher volume to smooth price shocks, and make markets more liquid. In contrast, weak market liquidity tends to increase volatility, which leads to variation margin and collateral calls that

reduce funding liquidity. Market liquidity shocks strain a trader's ability to fund its positions, as additional funds (for instance, to meet variation margin calls) can be raised only by selling assets into a falling market.

This mutual dependence creates the potential for market instability.^b Consider the trading losses from a price shock. If the losses are severe enough to seriously erode traders' capital, then risk management trading limits that are defined relative to capital would compel traders to reduce their trading, and market liquidity would decline. At the same time, the increased volatility that typically accompanies price declines can lead to higher initial margin and collateral calls, which raise the cost of maintaining trading positions and reduce funding liquidity (Brunnermeier and Pedersen 2006). If the shock is large enough, a financially constrained trader will be compelled to sell assets, further depressing prices in the market under stress or transmitting the price shock to other markets as positions in those markets are liquidated to meet cash demands. These sales depress prices even more, causing a further negative shock to trading positions and setting in motion additional asset sales and a downward spiral in asset prices.

A natural question is what market mechanisms or policy responses would halt or reverse a downward liquidity spiral or bring about a recovery from an illiquid equilibrium. If hedge funds and other traders, who normally smooth out market imbalances and liquidity shocks, are themselves weakened by losses brought on by unusually large market shocks, which investors would step in as buyers, and what policies would encourage or promote their stabilizing behavior in a crisis? This is fundamentally a question about the limits to arbitrage, and it highlights some of the trade-offs that accompany hedge funds' growing role in financial markets.

^aThe role of hedge funds as liquidity providers has been documented; for example, the Agarwal, Daniel, and Naik (2007) study of the convertible bond market and the Mitchell and Pulvino (2001) study of merger arbitrage demonstrate hedge funds' role as creators of liquidity.

^bFollowing the 1987 stock market crash, a growing body of research has arisen on trading-driven positive feedback in asset prices and liquidity. Among the earlier papers are DeLong et al. (1990), Gennotte and Leland (1990), and Grossman (1988). Recent examples include Brunnermeier and Pedersen (2006) and Shin (2006). Kambhu (2006) provides empirical evidence on the relationship between funding liquidity and market liquidity in convergence trading in the interest rate swap market.

in the early 1990s that bank loan losses in commercial real estate and the need to raise capital combined to create a "credit crunch" that exacerbated the U.S. recession in 1990-91. The concern now, of course, is that worrisome bank exposure is to hedge funds and capital markets, rather than to commercial real estate.

Discussions of this type of direct linkage from hedge funds to real economic activity through the banking system are common (see, for example, President's Working Group on Financial Markets [1999], Financial Stability Forum [2000, 2007], Chan et al. [2006], Garbaravicius and Dierick [2005],

Bernanke [2006], McCarthy [2006], and Hildebrand [2007]). While the magnitude of this exposure remains unclear, the Bank for International Settlements estimates that banks' direct exposure to hedge funds has been growing proportionately with the hedge fund industry itself.²⁰ It should be noted, however, that banks' current exposures to hedge funds are heavily collateralized and that the Financial Stability Forum (2007, p. 12) estimates that both the current and potential exposures, net of collateral, of core firms to hedge funds are quite modest in the aggregate. Moreover, each bank has a clear self-interest to manage and mitigate the risk of these exposures, although, as we discuss in Section 4, market discipline through counterparty credit risk management is not a panacea.

A second mechanism operates if hedge fund difficulties disrupt broad financial market activity, interrupt the efficient functioning of the capital markets, and hinder the broader provision of credit. It was feared, for example, that the market disruption surrounding the collapse of LTCM might impair the functioning of the credit and interest rate markets, and thus impede the provision of credit (McDonough 1998). This disruption of capital markets fundamentally reflects the loss of confidence of investors and a reduced ability or willingness to bear risk through the provision of credit (Counterparty Risk Management Policy Group II 2005). To the extent that this truly reflects an issue of investor confidence and not underlying fundamentals, it suggests an opportunity for policy intervention to shift market participants from a "bad" to a "good" equilibrium.

We emphasize that it is precisely the defining characteristics of hedge funds discussed earlier that create the potential for a substantial market disruption. For example, the funds' opacity and incentive structure may increase the likelihood of such an event as managers turn toward high-risk strategies with substantial tail-risk. Leverage, in turn, may amplify the impact of a given shock and result in larger and wider losses, as in the classic example of LTCM in the fall of 1998. Indeed, the President's Working Group on Financial Markets (1999), Chan et al. (2006), and others have highlighted excessive leverage as the key issue driving systemic concerns associated with hedge funds. Finally, the complexity and heterogeneity of the instruments may make the unwinding of positions more difficult, which would impede a timely and efficient workout and exacerbate the market impact.

A third systemic mechanism operates indirectly through the banking system. As discussed earlier, large commercial banks and broker-dealers provide substantial liquidity to the hedge fund sector by absorbing the counterparty credit exposure of trading positions, collateralizing financing, providing

contingent credit lines, and making direct equity stakes. A hedge-fund-induced shock to a commercial bank could have knock-on effects if that bank (or other banks) reduces the provision of liquidity to other hedge funds or to other banks, and thus further disrupts financial markets and credit provision. Shin (2006), for example, argues that interlinkages of bank balance sheets create complex dynamics that can amplify an initial price shock.

These mechanisms are all conceptual in nature, and there is considerable uncertainty about how they might work in practice. For example, recent evidence shows that commercial

When a crisis occurs, U.S. investors now seem to run to banks, not away from them. It is unclear, however, how effective this substitution of bank credit for capital market credit would be over longer periods if capital market disruptions persisted.

banks provided considerable stabilization during the market disruption in the fall of 1998 (Saidenberg and Strahan 1999; Gatev, Schuermann, and Strahan 2006). In particular, when credit spreads rose and commercial paper markets dried up in October 1998, banks were in the position to provide credit, primarily through unused loan commitments and draw-downs on existing lines of credit, as transaction deposits flowed into the banking sector. Fearing that "growing caution by lenders and unsettled conditions in financial markets more generally [were] likely to be restraining aggregate demand in the future," the Federal Reserve decreased the target fed funds rate by 25 basis points on September 29, 1998, again on October 15, and once more on November 17, where it remained for a year.²¹ In that episode, the Fed's injection of liquidity combined with normal market mechanisms alleviated the pressure from the short-run disruptions to the capital markets, so that a financial market crisis, driven by a hedge fund collapse, had minimal real effects and did not reach systemic proportions. When a crisis occurs, U.S. investors now seem to run to banks, not away from them. It is unclear, however, how effective this substitution of bank credit for capital market credit would be over longer periods if capital market disruptions persisted.

²⁰As reported in Garbaravicius and Dierick (2005).

²¹The announcement can be found at <<http://www.federalreserve.gov/boarddocs/press/monetary/1998/>>.

4. LIMITATIONS TO COUNTERPARTY CREDIT RISK MANAGEMENT

We now turn to our central question: Is CCRM, particularly by banks and securities firms, sufficient to limit risk-taking by hedge funds and constrain systemic risk to socially efficient levels? Financial regulators in the United States and abroad have for many years been guided by the principle that CCRM—not hedge fund regulation—is the optimal way to control hedge fund leverage and limit systemic vulnerabilities (see, for example, President’s Working Group on Financial Markets [1999], Financial Stability Forum [2000, 2007], Counterparty Risk Management Policy Group II [2005], Financial Services Authority

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[2005], Parkinson [2006], and Bernanke [2006]). Most recently, the President’s Working Group on Financial Markets (2007) concluded that “market discipline most effectively addresses the systemic risks posed by private pools of capital.”

To assess the question of why CCRM might prove insufficient, it is useful to examine potential market failures (in a textbook sense of deviations from a perfectly competitive, full-information economy that efficiently allocates resources) in the provision of credit. These market failures include agency problems, externalities, free-rider problems, moral hazard, and coordination failures. We emphasize that these concerns apply more generally to many types of credit provision, but are likely more acute where information problems are most severe, where banks are eager to capture a share of a growing market, and where potential profits are encouraging stiff competition. Hedge fund exposures fit this description quite well, which makes them particularly vulnerable to the erosion of CCRM.²²

²²See Lacker (2006) for a skeptical perspective on the importance of market failures.

4.1 Agency Problems

An agency problem exists when participants have different incentives, and information problems prevent one party (the principal) from perfectly observing and controlling the actions of the second (the agent).²³ In this case, the agent may act in its own self-interest in a way that is detrimental to the principal. In terms of hedge funds, these agency problems may exist within the dealer/bank (for example, a trader versus a risk manager), within the hedge fund (for example, the hedge fund manager versus an investor), or in the credit relationship between the bank and the hedge fund.

An agency problem is likely to develop within the dealer/bank as a struggle between insiders (those who do the trading or establish the prime broker relationships) and outsiders (those who do not, such as risk managers, owners, or outside creditors). Because of different incentives and internal informational asymmetries, a trader or salesperson at a large dealer/bank may have less risk aversion and shorter horizons than the firm’s management as his participation in the short-run upside exceeds participation in the downside (Allen 2003).²⁴ The opacity of the hedge fund counterparty is likely to exacerbate these difficulties, as it is harder for outsiders who are less informed of the fund’s risk profile to determine the appropriate counterparty risk ratings that drive credit terms, such as initial margin or limits on the size of business conducted with the fund. These concerns are particularly severe when the normal business practice is to earn fees upfront, while potential losses fall in the future.²⁵ As a result, insiders’ incentives will lead to excess risk-taking (from the firm’s and society’s perspective), which is possible in situations where information asymmetries prevent outsiders from perfectly observing, understanding, and controlling the actions of insiders (John and John 2006).

A second type of agency problem emerges between hedge fund managers and the fund’s investors due to the combination

²³This is a specific type of moral hazard, a situation where individuals maximize their own outcomes at the expense of others. This can occur when they do not bear the full consequences of their actions (a lack of insurance) or when information asymmetries prevent complete contracting (shirking on the job).

²⁴Recent examples include a trader at Barings and one at Allied Irish Bank, both of whom made unauthorized trades that were subsequently hidden from the relevant risk managers (Allen 2003).

²⁵This issue of compensation and risk-taking incentives is familiar to bankers who extend long-term loans when performance, including default, may not be known for many years. Indeed, a 1995 Federal Reserve Letter on Bank Lending Terms and Standards (Division of Banking Supervision and Regulation, SR95-36) addresses precisely this point with regard to corporate lending (see <<http://www.federalreserve.gov/boarddocs/SRLATTERS/1995/sr9536.htm>>).

of opacity of hedge fund strategies and the total-return-based compensation structures of hedge fund managers. Rajan (2005) warns about compensation structures in financial services that are more commonly convex, that is, increase strongly with good performance, but fall only mildly with poor performance. This convexity creates strong incentives to take on risks, and with lower transparency it is easier to hide those risks from both investors and counterparties. Moreover, Rajan points out that the risks that are more easily concealed “are ‘tail’ risks—that is, risks that have a small probability of generating severe adverse consequences and, in exchange, offer generous compensation the rest of the time.” One such example where hedge funds are significant players is credit derivatives.²⁶ Rajan (2005) adds that:

“[m]ost of the time, I will look as if I am outperforming my comparison group for I will have generated returns with no apparent risk. But every once in a while, disaster will strike and the creditor will default. My true risk profile will then be revealed but too late for my investors.”

One might expect that the long-run self-interest of hedge fund managers would curtail excess risk-taking, but there is abundant anecdotal evidence that even managers of failed hedge funds are able to raise capital in subsequent funds. Similarly, traders who lose their jobs over trading losses are often able to obtain new employment as traders. The reason for these perhaps surprising facts is the inherent difficulty in distinguishing managers/traders with talent from those without talent, that is, to estimate “alpha,” excess returns uncorrelated with market risk.

As a related point, there is a common perception that the convex payoffs from the high-water-mark contract of hedge fund managers increase incentives for risk-taking and contribute to agency problems. Rosenberg (2006) finds empirical evidence that the volatility of hedge funds’ returns tends to increase as the returns fall below their high-water mark, and that the volatility increase is largest for funds with an incentive fee and high-water-mark provision. Panageas and Westerfield (2006), however, show that a high-water mark need not lead to greater risk-taking ex ante if hedge fund managers have a long horizon. Intuitively, the manager takes into account that being “under water” in the future is costly, increasing his risk aversion today.

In general, any solution to agency problems must balance the proper incentives with appropriate controls that limit excess risk-taking, such as credit risk mitigation practices that attempt to control exposure and loss given default. Practices

²⁶John and John (2006) show how such convex compensation structures can indeed increase systemic instability.

such as initial and variation margin, collateralization of exposures, trading limits, and internal reporting systems can all serve this purpose. These practices are commonly used by dealers, but the critical question is how effectively they are implemented and under what conditions they may be waived. For example, a firm’s risk manager’s preferred level of initial margin to be imposed on a hedge fund may be quite different from the level preferred by the trader who owns an implicit option on the income generated by the trading relationship with the hedge fund.

4.2 Externalities

An externality is an impact of one party’s action on others who are not directly involved in the transaction. Credit exposure to hedge funds may create externalities in the banking system or broader financial markets in several ways. If the potential exposure amounts to a significant share of bank capital, for example, then a large shock to hedge funds could weaken banks and impair their ability to provide liquidity to the financial system or credit to borrowers. This can be considered an externality, as the impact is felt by market participants not directly involved in the original transaction, such as a corporate borrower that relies on a bank that suddenly becomes weakened.

A second way in which hedge fund exposures may generate externalities is in the common exposures to market risk factors across hedge funds and the dealer’s own proprietary trading activity. The price impact of hedge

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funds’ defensive trading or dynamic hedging after a shock to a position, for example, could further adversely affect the dealer’s similar proprietary trading position. This, of course, relies on similarity in the market risk profiles of hedge funds and dealers, which could be aligned or offsetting. To the extent they are aligned, such a shock would potentially magnify the impact beyond the direct effect of the bank’s credit exposure to hedge funds.

Whether these are in fact systemic issues depends on the size of the exposures relative to bank capital and the impact on the provision of credit. For large diversified banks, trading risk tends to be small relative to the credit risk in their loan book and small relative to current capital levels. With regard to credit exposure to hedge funds, the Financial Stability Forum (2007), for example, reports that the potential counterparty exposure of core firms to hedge funds is approximately between 3 percent and 10 percent of Tier 1 capital, and it concludes that “the size of direct exposure would not be alarming even if one assumed a wide margin of error” (p. 12).

Jorion (2006) examines the correlation of market risk capital charges and trading revenues across eleven large U.S. banks. Measured in this way, these banks turn out to have a fairly diversified exposure profile. O’Brien and Berkowitz (2006), using proprietary trading profit-and-loss data, show significant exposure heterogeneity across dealers. Another way to address the question of whether a correlated shock in the hedge fund and trading businesses is material relative to bank capital would be to conduct an integrated stress test across counterparty exposures and trading exposures at a dealer. A challenge in conducting such a stress test would be the selection of risk factors against which to assess the exposures. Many hedge funds and banks do not take simple directional trades against broad market risk factors. Instead, their trades tend to be spread trades between related securities, and these exposures would not be visible unless a stress test were conducted at a very high level of granularity in the representation of positions and risk factors. (See Box 3 for details on correlation risk and hedge funds.)

A related idea is the “public good” nature of financial market stability that generates a free-rider problem in terms of CCRM.²⁷ Consider, for example, a large hedge fund that has exposures with many banks, all of whom benefit from the health of the hedge fund. While in principle every bank should monitor its exposure and limit excess risk-taking by the hedge fund, each bank also has an incentive to free-ride by reducing its CCRM and enjoying the benefits of the CCRM of the other banks. This is a classic example of “tragedy of the commons,” where private markets may underprovide the public good and create a rationale for official sector intervention.

This public-good concern may be exacerbated by liquidity risk. If very large positions are fundamentally different than smaller ones—for example, due to price feedback effects if the position needs to be liquidated in a time of stress, as described in Box 2—then CCRM may not provide enough collective

²⁷A public good is both nonrival (use by one person does not preclude use by others) and nonexcludable (available to all). It is related to an externality because one person’s provision of the good benefits others.

Box 3

Hedge Funds and Correlations

Are hedge fund returns more correlated than the returns of other asset managers? And if so, does the increased correlation stem from exposure to common risk factors or some other source of dependence or commonality? Finally, do these correlations get “worse” during periods of market turmoil? Affirmative answers to these questions would cause concern about the unusual effect hedge funds may have on the financial system in adverse market conditions.

As perhaps befitting their name, hedge fund returns tend to be only weakly (linearly) correlated with broad market returns (Fung and Hsieh 1999; Boyson, Stahel, and Stulz 2006), although Garbaravicius and Dierick (2005) provide evidence that this correlation has been increasing in recent years. Yet the European Central Bank (2006, p. 134) documents that hedge funds have become more correlated with each other: “the levels reached in late 2005 exceeded those that had prevailed just before the near-collapse of [Long-Term Capital Management].” Adrian (2007), however, concludes that this primarily reflects lower overall volatility in the recent period.

The picture becomes somewhat more complex when one looks beyond linear dependence. Boyson, Stahel, and Stulz (2006) analyze co-occurrences of extreme moves (5 percent to 15 percent tail events), which they call contagion. They find no supporting evidence of contagion from extreme moves in the underlying risk factors—equity, fixed-income, and currency markets—but they do find evidence of contagion across hedge fund styles. One interpretation is that this simply reflects omitted risk factors, such as liquidity risk, which are common across styles. Alternatively, these findings may lend support to Rajan’s (2005) assertion of herding behavior among asset managers generally, a concern also raised by the Counterparty Risk Management Policy Group II (2005) in what it calls “crowded trades,” but disputed by EDHEC Risk and Asset Management Research Centre (2006). Overall, however, the conclusion drawn by Boyson, Stahel, and Stulz (2006) is worth noting:

“These results imply that systemic risk arising from poor performance in the broad markets is not amplified by contagion to the hedge fund industry” (p. 31).

discipline even in the absence of free-riding. This concern is amplified by the ability of a particular hedge fund to boost leverage through interaction with many dealers. While each dealer may have an incentive to monitor and control its own exposure, the opacity of a hedge fund’s risk profile means that no particular firm would have the ability to control a fund’s overall

leverage and exposure to risk. In this situation, the competitive equilibrium will not impose enough collective discipline.

4.3 Moral Hazard

Moral hazard refers to changes in behavior in response to redistribution of risk, for example, insurance may induce risk-taking behavior if the insured does not bear the full consequences of bad outcomes. In financial markets, the question of moral hazard from conjectural guarantees by the government—the implicit promise to bail out certain bank creditors—may apply to the largest commercial banks, but it does not apply to hedge funds. The resolution of the LTCM crisis, for example, was essentially an informal bankruptcy procedure in which LTCM’s stakeholders were largely wiped out in the recapitalization and ultimate liquidation of the fund by its dealer counterparties. Further, regulators continually disavow any “too-big-to-fail” policy for hedge funds.

In terms of the regulated largest financial intermediaries, however, their central role in the financial system raises the question of how large credit losses would affect regulators’ decisions about the regulated firm. As a result, a bank (and its counterparties) may arguably have less incentive to monitor, reduce risk, and limit exposure in activities whose current profitability and growth opportunities make them attractive to banks—such as in the hedge fund sector. This moral hazard issue for large financial intermediaries is relevant in all of their risk management decisions, however, not just those related to their hedge fund business. Furthermore, the substantial franchise value attributable to large financial institutions should help to mitigate somewhat these moral hazard issues.

4.4 Competition

A final concern about the breakdown of effective CCRM is that the apparent profits to be earned in this business may create competitive pressures that weaken credit risk mitigation practices. Bernanke (2006) and the Financial Stability Forum (2007), for example, discuss how competition for new hedge fund business may be eroding CCRM, such as through lower than appropriate fees and spreads, or inadequate risk controls such as lower initial margin levels, collateralization practices, or exposure limits.²⁸

²⁸This is not a new concern. See President’s Working Group on Financial Markets (1999) for similar concerns about potentially harmful effects of competition for hedge fund business.

While this is not a market failure per se, the U.S. banking sector has a history of periods in which lax CCRM contributed to substantial credit losses and potential systemic consequences: the less-developed-country debt crisis of the late 1970s and early 1980s; excessive commercial real estate lending in the late 1980s; possibly the weak counterparty credit measures in the 1990s that allowed LTCM to take on enormous leverage in many markets; and most recently the subprime mortgage market. As mentioned earlier, this deterioration may partially reflect inefficient compensation schemes and short horizons of lenders, although some portion of the adverse outcomes simply reflects the underlying, negative shocks.

A complicating factor, however, is that competition and expected profit typically improve efficiency and erode economic rents by inducing entry. This makes it more difficult

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for outside observers to assess whether claims of competitive excess are real or the complaint of incumbents whose profits are being eroded by competition. This type of competition may actually be socially efficient if earlier margins, for example, were “too high” and unduly restricted activity.

The economics literature has revealed very little on the interaction of competition and risk management discipline on practices such as initial margin levels. This is because relevant data are not available, for example, on the distribution of dealers’ hedge fund business by counterparty risk class, how it has changed, how measures of hedge fund creditworthiness vary across dealers, and how they relate to potential future exposure and risk mitigation practices such as initial margin. This remains an important question for future research.

5. IMPLICATIONS FOR REGULATION

A typical economist’s view is that market participants enter into transactions with a full understanding of the benefits and costs of their actions. To the extent that participants are well-informed and all the costs and benefits accrue to those making

the transaction, a perfectly competitive environment leads to a laissez-faire level of systemic risk that is socially efficient, so there is no rationale for regulation or intervention. Additional direct regulation would likely reduce social welfare due to less activity, entry deterrence, stifled innovation, limited competition, distorted behavior and regulatory arbitrage, increased moral hazard, and direct compliance costs.

As we discussed earlier, however, the textbook description of perfect competition is typically not appropriate in all financial and credit markets, where agency problems, externalities, and moral hazard are common. As a result, the laissez-faire level of systemic risk may be too high from society's perspective, raising the question of whether regulation

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may potentially improve outcomes. Indeed, a key lesson from the collapse of LTCM is that market participants may not be sufficiently cognizant of the risks they face and therefore not vigilant enough in constraining counterparty risk.

Since LTCM, however, CCRM has greatly improved. The Counterparty Risk Management Policy Group II (2005), Mercer Oliver Wyman (2006), and the Financial Stability Forum (2007), for example, note improved risk management techniques by counterparties, improved supervision, more effective disclosure and transparency, strengthened financial infrastructure, and more effective hedging and risk distribution techniques. Moreover, the institutionalization of hedge funds, driven by demands of new investors such as hedge fund of funds and other institutional investors, is increasing discipline and transparency. More research on the role of hedge fund of funds as both a stabilizing force (through increased discipline and reallocation of capital to better performers) and a destabilizing force (as a source of "hot money") would likely be fruitful.

Despite these gains, if systemic risk reflects an externality or public-good problem, then by definition even well-informed market participants will not have an incentive to adequately

monitor or limit those risk-generating actions and there is a role for regulation to reduce inefficient systemic risk (President's Working Group on Financial Markets 1999; Bernanke 2006). Effective policy, however, needs to be able to precisely identify and to quantify the externality in order to determine the appropriate policy (Financial Services Authority 2005). Moreover, we have no evidence that externalities relating to hedge funds are unique. Therefore, a second area of research is to examine whether externalities relating to hedge funds are more acute than in other areas of bank lending, where stronger CCRM remains the appropriate policy response.

A more forceful alternative—outright regulation of hedge funds such as through activity restrictions, required capital, or leverage restrictions—has not received much attention and could have substantial costs. Activity restrictions that dramatically limit trading strategies such as short-selling or the use of derivative investments, for example, would likely diminish the beneficial effect of hedge funds on market liquidity and price discovery, thereby reducing the benefits along with the costs. Required capital ratios would be difficult to set optimally and would likely lead to increased regulatory arbitrage. Outright regulation might be expected to increase moral hazard if it increases the appearance of regulatory approval or simply the shift of activity to a less regulated jurisdiction. With a heavy regulatory hand, there is a risk of hedge funds moving totally off-shore; regulators might go from seeing little to seeing nothing. Finally, the historical policy response to lax CCRM has not been to regulate the borrower, but to increase oversight of the lenders, so regulation of hedge funds would be a significant departure from policy precedents.²⁹

A second alternative is the mandatory provision of more information to regulators and the investment community. In principle, better informed investors would be increasingly able to monitor and discipline hedge funds, and thus reduce excess risk-taking. One specific idea raised by the President's Working Group on Financial Markets (1999) was improvement in the disclosure of hedge funds' risk profiles to their investors and counterparties. Timely and meaningful disclosures that do not compromise legitimate commercial interests of a hedge fund would help address the information asymmetries related to the market failures discussed above. Another specific idea raised by some is the creation of a large database, maintained by the official sector, that aggregates and records hedge fund

²⁹In response to excessive commercial real estate lending in the property boom of the 1980s, regulators established stronger supervisory guidance on property lending, while the banks and property developers devised innovative financing arrangements involving securitization that shifted some of the risk out of the banking sector. Significantly, no one proposed that commercial property developers become regulated institutions.

exposures on a real-time basis. It is not clear, however, how the official sector could effectively analyze the enormous quantity of information or act on it given the heterogeneous nature of positions and exposures, and this would undoubtedly be a very costly exercise (Bernanke 2006). Moreover, disclosure does not solve the externality problem or address all of the agency issues.

A third alternative, discussed by the Financial Services Authority (2005) and the Counterparty Risk Management Policy Group II (2005), is to encourage through moral suasion “best-practice” techniques for risk management and measurement, both within institutions and in terms of market infrastructure. Meaningful best-practice efforts spearheaded by the official sector or industry groups can leverage market discipline and encourage institutions to meet generally agreed-upon standards in terms of accounting, transparency, and risk management. For market infrastructure issues, the recent work led by the Federal Reserve Bank of New York and other

regulators on credit derivatives clearing and settlement shows how market participants may not have adequate private incentives to provide essential “plumbing” that is good for all. This is a classic example of a public good that needs to be provided by the official sector to avoid the “tragedy of the commons,” in this case, systemic risk. Other examples may include improved clarity around legal arrangements for prime brokerage activities and valuation standards for complex, illiquid products.

We conclude that the current emphasis on market discipline and CCRM as the primary check on hedge fund risk-taking is appropriate. If systemic risk were to originate through direct banking sector exposures, for example, then the banks themselves would have the strongest incentive to monitor those exposures and limit risk. While various market failures may make CCRM imperfect, it remains the best line of defense against systemic risk.

REFERENCES

- Ackermann, C., R. McEnally, and D. Ravenscraft. 1999. "The Performance of Hedge Funds: Risk, Returns, and Incentives." *JOURNAL OF FINANCE* 54, no. 3 (June): 833-74.
- Adrian, T. 2007. "Measuring Risk in the Hedge Fund Sector." Federal Reserve Bank of New York *CURRENT ISSUES IN ECONOMICS AND FINANCE* 13, no. 3 (March/April).
- Agarwal, V., N. D. Daniel, and N. Y. Naik. 2007. "Role of Managerial Incentives and Discretion in Hedge Fund Performance." Unpublished paper, Georgia State University, March 1. Available at <<http://ssrn.com/abstract=889008>>.
- Allen, S. 2003. *FINANCIAL RISK MANAGEMENT: A PRACTITIONER'S GUIDE TO MANAGING MARKET AND CREDIT RISK*. Hoboken, N.J.: John Wiley and Sons.
- Almazan, A., K. C. Brown, M. Carlson, and D. A. Chapman. 2004. "Why Constrain Your Mutual Fund Manager?" *JOURNAL OF FINANCIAL ECONOMICS* 73, no. 2 (August): 289-321.
- Ashcraft, A. 2005. "Are Banks Really Special? New Evidence from the FDIC-Induced Failure of Healthy Banks." *AMERICAN ECONOMIC REVIEW* 95, no. 5 (December): 1712-30.
- Banque de France. 2007. "Special Issue on Hedge Funds." *FINANCIAL STABILITY REVIEW* 10, April. Available at <http://www.banque-france.fr/gb/publications/rsf/rsf_042007.htm>.
- Bernanke, B. S. 2006. "Hedge Funds and Systemic Risk." Remarks delivered at the Federal Reserve Bank of Atlanta's 2006 Financial Markets Conference—Hedge Funds: Creators of Risk? May 16.
- Bernanke, B. S., and M. Gertler. 1989. "Agency Costs, Net Worth, and Business Fluctuations." *AMERICAN ECONOMIC REVIEW* 79, no. 1 (March): 14-31.
- Bordo, M. D., B. Mizrach, and A. J. Schwartz. 1998. "Real versus Pseudo-International Systemic Risk: Some Lessons from History." *REVIEW OF PACIFIC BASIN FINANCIAL MARKETS AND POLICIES* 1, no. 1 (March): 31-58.
- Boyson, N. M., C. W. Stahel, and R. M. Stulz. 2006. "Is There Hedge Fund Contagion?" NBER Working Paper no. 12090, March.
- Brunnermeier, M., and L. Pedersen. 2006. "Market Liquidity and Funding Liquidity." Unpublished paper, Princeton University.
- Carhart, M. M., J. N. Carpenter, A. W. Lynch, and D. K. Musto. 2002. "Mutual Fund Survivorship." *REVIEW OF FINANCIAL STUDIES* 15, no. 5 (winter): 1439-63.
- Chan, N., M. Getmansky, S. M. Haas, and A. W. Lo. 2006. "Systemic Risk and Hedge Funds." In M. Carey and R. Stulz, eds., *RISKS OF FINANCIAL INSTITUTIONS*, 235-330. Chicago: University of Chicago Press.
- Counterparty Risk Management Policy Group II. 2005. "Toward Greater Financial Stability: A Private Sector Perspective." July 27. Available at <<http://www.crmpolicygroup.org/>>.
- DeBandt, O., and P. Hartman. 2002. "Systemic Risk: A Survey." In C. A. E. Goodhart and G. Illing, eds., *FINANCIAL CRISIS, CONTAGION, AND THE LENDER OF LAST RESORT: A BOOK OF READINGS*. London: Oxford University Press.
- DeLong, J. B., A. Schleifer, L. Summers, and R. Waldman. 1990. "Positive Feedback Investment Strategies and Destabilizing Rational Speculation." *JOURNAL OF FINANCE* 45, no. 2 (June): 379-95.
- Demsetz, R. S., and P. E. Strahan. 1997. "Diversification, Size, and Risk at Bank Holding Companies." *JOURNAL OF MONEY, CREDIT, AND BANKING* 29, no. 3 (August): 300-13.
- EDHEC Risk and Asset Management Research Centre. 2006. "Disorderly Exits from Crowded Trades? On the Systemic Risks of Hedge Funds." Available at <<http://www.edhec-risk.com/edito/RISKArticleEdito.2006-07-27.4050>>. Registration required.
- Elsinger, H., A. Lehar, and M. Summer. 2006. "Risk Assessment for Banking Systems." *MANAGEMENT SCIENCE* 52, September: 1301-14.
- Elton, E. J., M. J. Gruber, and C. R. Blake. 2003. "Incentive Fees and Mutual Funds." *JOURNAL OF FINANCE* 58, no. 2 (April): 779-804.
- European Central Bank. 2006. *FINANCIAL STABILITY REVIEW*. June. Available at <<http://www.ecb.int/pub/pdf/other/financialstabilityreview200606en.pdf>>.

REFERENCES (CONTINUED)

- Financial Services Authority*. 2005. "Hedge Funds: A Discussion of Risk and Regulatory Engagement." Discussion Paper no. 05/4, June.
- Financial Stability Forum*. 2000. "Report of the Working Group on Highly Leveraged Institutions." April 5.
- . 2007. "Update of the FSF Report on Highly Leveraged Institutions." May 19.
- Flannery, M. J., S. H. Kwan, and M. Nimalendran*. 2004. "Market Evidence on the Opaqueness of Banking Firms' Assets." *JOURNAL OF FINANCIAL ECONOMICS* 71, no. 3 (March): 419-60.
- Fung, W., and D. A. Hsieh*. 1999. "A Primer on Hedge Funds." *JOURNAL OF EMPIRICAL FINANCE* 6, no. 3 (September): 309-31.
- Fung, W., D. Hsieh, N. Naik, and T. Ramadorai*. 2006. "Hedge Funds: Performance, Risk, and Capital Formation." Unpublished paper.
- Garbaravicius, T., and F. Dierick*. 2005. "Hedge Funds and Their Implications for Financial Stability." European Central Bank OCCASIONAL PAPERS, no. 34, August.
- Gatev, E., T. Schuermann, and P. E. Strahan*. 2006. "How Do Banks Manage Liquidity Risk? Evidence from the Equity and Deposit Markets in the Fall of 1998." In M. Carey and R. Stulz, eds., *RISKS OF FINANCIAL INSTITUTIONS*, 105-30. Chicago: University of Chicago Press.
- Genotte, G., and H. Leland*. 1990. "Market Liquidity, Hedging, and Crashes." *AMERICAN ECONOMIC REVIEW* 80, no. 5 (December): 999-1021.
- Greenwich Associates*. 2006. "For Hedge Funds, Fixed-Income Trading Volumes Soar, While Costs Take on New Importance." Research report, August.
- Grossman, S.* 1988. "An Analysis of the Implications for Stock and Futures Price Volatility of Program Hedging and Dynamic Hedging Strategies." *JOURNAL OF BUSINESS* 61, no. 3 (July): 275-98.
- Gupta, A., and B. Liang*. 2005. "Do Hedge Funds Have Enough Capital? A Value-at-Risk Approach." *JOURNAL OF FINANCIAL ECONOMICS* 77, no. 1 (July): 219-53.
- Hahn, R. W., and C. R. Sunstein*. 2005. "The Precautionary Principle as a Basis for Decision Making." *THE ECONOMISTS' VOICE* 2, no. 2 (Article 8).
- Hildebrand, P. M.* 2007. "Hedge Funds and Prime Broker-Dealers: Steps Towards a 'Best Practice Proposal.'" *Banque de France FINANCIAL STABILITY REVIEW* 10, April: 73-83.
- John, K., and T. A. John*. 2006. "Managerial Incentives, Derivatives, and Stability." *JOURNAL OF FINANCIAL STABILITY* 2, no. 1 (April): 71-94.
- Jorion, P.* 2006. "Bank Trading Risk and Systemic Risk." In M. Carey and R. Stulz, eds., *RISKS OF FINANCIAL INSTITUTIONS*, 29-58. Chicago: University of Chicago Press.
- . 2007. *VALUE AT RISK*. 3rd ed. New York: McGraw Hill.
- Kambhu, J.* 2006. "Trading Risk, Market Liquidity, and Convergence Trading in the Interest Rate Swap Spread." Federal Reserve Bank of New York *ECONOMIC POLICY REVIEW* 12, no. 1 (May): 1-13.
- Lacker, J. M.* 2006. "How Should Regulators Respond to Financial Innovation?" Remarks delivered at The Philadelphia Fed Policy Forum 2006, December 1. Available at <http://www.philadelphiafed.org/econ/conf/forum2006/papers/lacker_speech.pdf>.
- Lowenstein, R.* 2000. *WHEN GENIUS FAILED: THE RISE AND FALL OF LONG-TERM CAPITAL MANAGEMENT*. New York: Random House.
- McCarthy, C.* 2006. "Hedge Funds: What Should Be the Regulatory Response?" Remarks delivered at the SUERF European Money and Finance Forum 2006, December 7. Available at <<http://www.fsa.gov.uk/pages/Library/Communication/Speeches/2006/1207cm.shtm>>.
- McDonough, W. J.* 1998. "Statement before the Committee on Banking and Financial Services." U.S. House of Representatives, October 1.
- Mercer Oliver Wyman*. 2006. "New Study Reveals Strengthened Global Hedge Fund Industry Risk Management Practices and Highlights Areas for Improvement." Press release, June 20. Available at <http://www.oliverwyman.com/ow/pdf_files/Global_Hedge_Fund_RM_MOW_0606.pdf>.

REFERENCES (CONTINUED)

- Mitchell, M., and T. Pulvino.* 2001. "Characteristics of Risk and Return in Risk Arbitrage." *JOURNAL OF FINANCE* 56, no. 6 (December): 2135-75.
- Morgan, D. P.* 2002. "Rating Banks: Risk and Uncertainty in an Opaque Industry." *AMERICAN ECONOMIC REVIEW* 92, no. 4 (September): 874-88.
- O'Brien, J., and J. Berkowitz.* 2006. "Estimating Bank Trading Risk: A Factor Model Approach." In M. Carey and R. Stulz, eds., *RISKS OF FINANCIAL INSTITUTIONS*, 59-101. Chicago: University of Chicago Press.
- Panageas, S., and M. Westerfield.* 2006. "High-Water Marks: High-Risk Appetites? Convex Compensation, Long Horizons, and Portfolio Choice." Unpublished paper, University of Southern California and University of Pennsylvania, Wharton School.
- Paredes, T. A.* 2006. "On the Decision to Regulate Hedge Funds: The SEC's Regulatory Philosophy, Style, and Mission." Washington University in St. Louis School of Law, Faculty Working Paper Series, no. 6-03-02.
- Parkinson, P. M.* 2006. "The Role of Hedge Funds in the Capital Market." Testimony before the Subcommittee on Securities and Investment, Committee on Banking, Housing, and Urban Affairs. U.S. Senate, May 16.
- President's Working Group on Financial Markets.* 1999. "Hedge Funds, Leverage, and the Lessons of Long-Term Capital Management." April 28. Available at <<http://www.treas.gov/press/releases/reports/hedgfund.pdf>>.
- . 2007. "Agreement among PWG and U.S. Agency Principals on Principles and Guidelines Regarding Private Pools of Capital." Available at <http://www.treas.gov/press/releases/reports/hp272_principles.pdf>.
- Rajan, R. G.* 2005. "The Greenspan Era: Lessons for the Future." Remarks delivered at the Symposium on Financial Markets, Financial Fragility, and Central Banking, sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, August 27.
- Rosenberg, J.* 2006. "When Hedge Funds Underperform: The Impact of Manager Compensation Type on Risk-Taking." Unpublished paper, Federal Reserve Bank of New York.
- Saidenberg, M. R., and P. E. Strahan.* 1999. "Are Banks Still Important for Financing Large Businesses?" *FEDERAL RESERVE BANK OF NEW YORK CURRENT ISSUES IN ECONOMICS AND FINANCE* 5, no. 12 (August).
- Santos, J. A. C.* 2006. "Why Firms' Access to the Bond Market Differs over the Business Cycle: A Theory and Some Evidence." *JOURNAL OF BANKING AND FINANCE* 30, no. 10 (October): 2715-36.
- Securities and Exchange Commission.* 2003. "Implications of the Growth of Hedge Funds." Staff report to the United States Securities and Exchange Commission, September.
- Shin, H. S.* 2006. "Risk and Liquidity in a System Context." BIS Working Paper no. 212, August.
- Stulz, R. M.* 2007. "Hedge Funds: Past, Present, and Future." *JOURNAL OF ECONOMIC PERSPECTIVES* 21, no. 2 (June): 175-94.

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