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Hedge funds and their prime brokers: developments since the financial crisis



Hedge funds and their prime brokers: developments since the financial crisis

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- Hedge funds are investment firms that manage capital on behalf of high net worth individuals and institutional investors. They can invest using complex strategies and instruments, often making use of borrowing and derivatives to generate leverage to magnify exposures. The hedge fund sector has grown rapidly in recent years and currently manages over US\$3.5 trillion of assets globally.
- Hedge funds trade frequently in financial markets and are therefore important for secondary market liquidity and price discovery. They are also interconnected with the banking system via their prime brokers, who provide financing via secured loans and derivative agreements.
- This article looks at some key developments in the hedge fund sector and their prime brokers since the financial crisis, drawing heavily on the Bank's Hedge Fund as Counterparty Survey and Market Intelligence function. It also outlines potential financial stability transmission channels arising from hedge funds, and how these have evolved following the financial crisis.

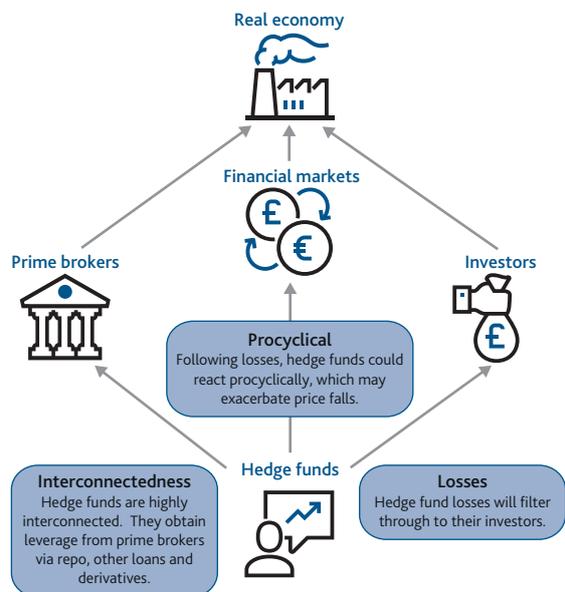
Overview

Hedge funds are of interest to the Bank because of: their importance for secondary market liquidity and price discovery; the significant use of leverage by some types of hedge funds; and their interconnections with a range of counterparties. Risks from and to hedge funds are therefore relevant to the Bank's Financial Policy Committee, whose primary objective is to identify, assess, monitor and take action in relation to financial stability risks across the UK financial system.

The global hedge fund industry has experienced dramatic growth since 2000, with assets under management increasing from US\$250 billion to over US\$3.5 trillion in 2017. Hedge funds operate a number of different strategies which dictate the markets they invest in and the leverage that they take.

Hedge funds are exposed to a number of risks, including risks from using leverage and liquidity risks from investor redemptions. Hedge funds can also transmit risk to the financial system (**summary figure**). Since the financial crisis, there have been changes which may serve to mitigate some of the risks. Hedge funds themselves have adjusted their business models, and international regulations, such as the Financial Stability Board's derivative reforms, have limited the risks that hedge funds pose to the financial system.

Summary figure Hedge fund transmission channels



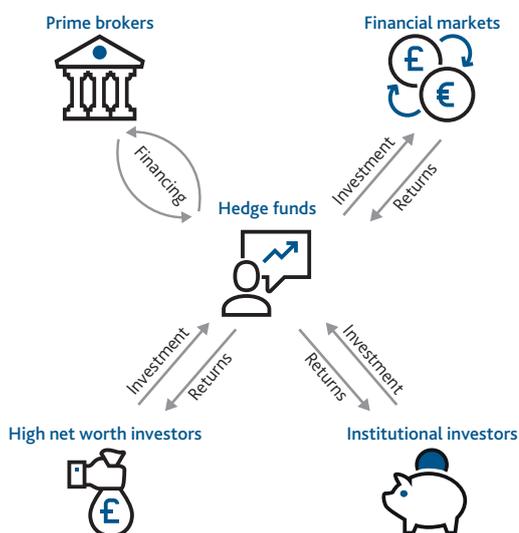
Hedge funds' main source of financing is via banks' prime brokerage services. In the wake of the financial crisis, prime brokers have adjusted their business models, for example there has been growth in the use of synthetic prime brokerage in place of traditional cash prime brokerage.

(1) The authors would like to thank Thomas Baines and Laura Silvestri for their help in producing this article.

Introduction

A hedge fund is typically an investment firm that manages capital on behalf of high net worth individuals and institutional investors such as pension funds, endowments and sovereign wealth funds. Hedge funds invest this capital in financial markets, utilising complex investment strategies and instruments. Hedge funds often make use of borrowing and derivatives to generate 'leverage', whereby they take on financial exposures in excess of their capital base, to increase returns. Hedge funds' main source of borrowing is via banks' prime brokerage services.⁽¹⁾ Prime brokers lend cash and securities to hedge funds, on a collateralised basis, which the funds in turn use to take positions in financial markets. These 'prime' services are typically offered by large banks (Figure 1).

Figure 1 How do hedge funds operate?



Hedge funds have the ability to take both long and short⁽²⁾ positions, and these short positions give hedge funds the opportunity to generate returns when asset prices fall. This ability to 'hedge' market risk is what historically gave rise to the name 'hedge fund'.

In the United Kingdom, hedge fund firms⁽³⁾ are regulated by the Financial Conduct Authority (FCA). In 2013, the United Kingdom implemented the Alternative Investment Fund Managers Directive (AIFMD)⁽⁴⁾ which increased the disclosure requirements and implements certain capital requirements. In addition, since the financial crisis, a number of other changes have been introduced to mitigate potential risks in the hedge fund industry. These are outlined in Section 2.

The Bank's Financial Policy Committee (FPC) has a primary objective to identify, monitor and take action in relation to financial stability risks across the UK financial system, including risks arising beyond the core banking sector. While

hedge funds are beneficial to the financial system due to their importance to secondary market liquidity and price discovery, they are an area of interest as they use leverage. Leverage enables funds to magnify returns, though it can also magnify losses. As a result, hedge funds face a number of risks, and have the potential to influence financial market movements. Furthermore, hedge funds tend to be highly interconnected with a range of counterparties, meaning they have the potential to spread risk through the financial system.

To help understand these risks, the Bank conducts a biannual 'Hedge Fund as Counterparty Survey' (HFACS) which captures data on hedge funds via their prime brokers (for more information see the box on page 3).⁽⁵⁾ The Bank also collects information via its Market Intelligence function, which gathers information directly from market participants.⁽⁶⁾ The combination of these two data sources gives the Bank a unique insight into the hedge fund and prime brokerage industries. Drawing heavily on these data sources, this article aims to highlight how the hedge fund industry has developed since the financial crisis, with particular focus on how these developments have impacted: (a) risks to hedge funds; and (b) ways in which hedge funds can transmit systemic risk to the wider financial system.

1 Trends in the hedge fund and prime brokerage industries

How big is the hedge fund industry?

The global hedge fund industry has experienced dramatic growth since 2000, with assets under management (AUM)⁽⁷⁾ increasing from US\$250 billion to over US\$3.5 trillion in 2017 (Chart 1). Hedge fund AUM can grow for two reasons: investors putting more capital into the funds; and the assets in the portfolio increasing in value. The 2017 International Organization of Securities Commissions (IOSCO) Global Hedge Fund Report⁽⁸⁾ suggests that the latter (investment performance) has played a key role in the recent increase in hedge fund AUM. The total number of funds in existence globally is estimated to be around 10,000–15,000, and the number of hedge fund firms is estimated at around 4,500.

(1) Prime brokers do offer services to other investor bases eg pension funds, but hedge funds tend to be their main clients.

(2) When taking a short position, the investor would borrow and then sell the asset, with a view to buying it back later at a lower price, in order to make a profit from the price difference.

(3) Hedge fund firms often control a number of different hedge funds. These hedge funds can operate different strategies, and produce varying returns.

(4) EU-based managers must comply with all provisions of AIFMD. Non-EU managers that market funds in the EU are subject to reporting requirements.

(5) The firms currently included in our survey are Bank of America Merrill Lynch, Barclays, Citigroup, Credit Suisse, Deutsche Bank, Goldman Sachs, HSBC, JPMorgan, Morgan Stanley, Royal Bank of Scotland, Société Générale and UBS.

(6) See Jeffery *et al* (2017).

(7) In the hedge fund industry, AUM is the total market value of assets that are managed on behalf of investors.

(8) See IOSCO (2017).

Hedge Fund as Counterparty Survey

The Hedge Fund as Counterparty Survey is a survey currently consisting of twelve prime brokers which have trading relationships with hedge funds via repo, secured financing (such as margin loans and secure lending) and derivatives. The survey started in April 2005, and is repeated every six months. The survey collects data on firms' global hedge fund operations.

Data are collected on firms' trading relationships with hedge funds via repo, secured financing and derivatives, which in turn provides an insight on exposures and further industry trends (Figure A). The survey collects data on prime brokers' total hedge fund exposures, as well as their top 20 individual fund exposures.

Figure A Hedge Fund as Counterparty Survey design

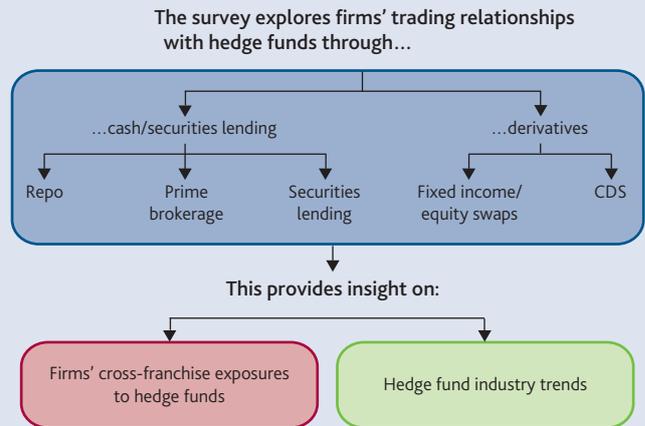
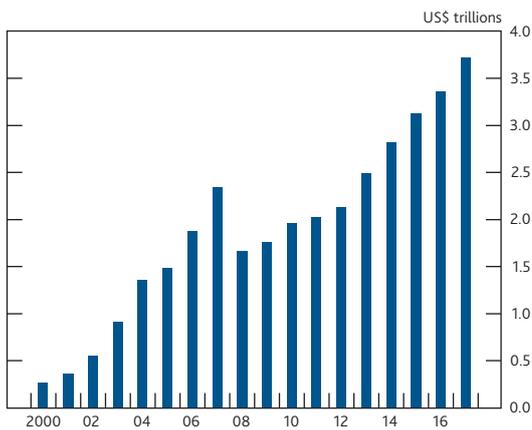


Chart 1 Global hedge fund assets under management^(a)



Sources: BarclayHedge and Bank calculations.

(a) Includes BarclayHedge data on both the Hedge Fund and Commodity Trading Advisor (CTA) industries.

What strategies do hedge funds use to invest?

Hedge funds are a diverse sector, making investments in line with a number of different strategies. These are briefly described in Figure 2.

One type of a fund that has been growing rapidly in recent years are so-called 'quant' funds. Quant funds do not follow one particular 'strategy', and hence are not separately defined in Figure 2. Instead, quant funds are funds that invest based on a set of rules calibrated from analysis of past patterns or trends in data. For more detail on the rise of quant funds, see the box on page 5.

Who invests in hedge funds?

Historically hedge fund investors were primarily high net worth individuals. This changed in the early 2000s when institutional investors, such as endowments and pension funds, began allocating more capital to hedge funds. This

increase in allocations has largely driven the increase in AUM for the hedge fund industry since the early 2000s. In 2003, 25% of hedge fund AUM was from institutional investors; by 2012, this reached 60%.

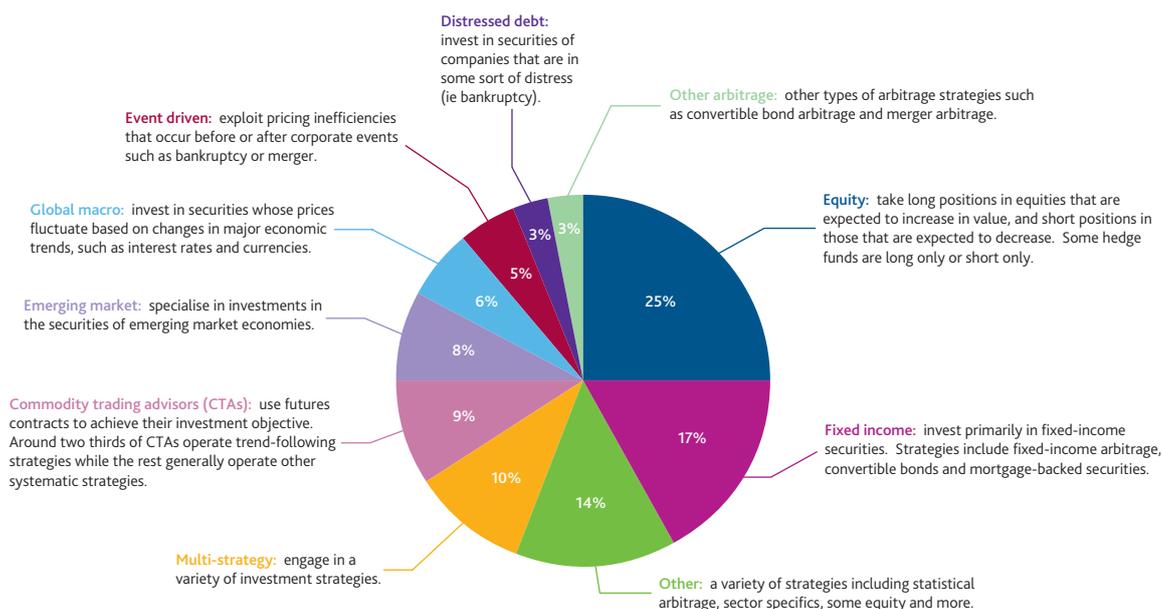
The Bank's market contacts report that one consequence of the inflow of institutional capital into hedge funds is an increased focus on risk management and transparency. Capital from these investors is generally considered to be more stable than capital from high net worth individuals, but comes with demands for lower fees⁽¹⁾ and greater transparency.

In the United Kingdom, hedge funds have become an increasingly popular investment for pension funds. Hedge funds now account for nearly 7% of total assets for UK defined-benefit pension funds, up from just 1.5% in 2009 (Chart 2). A reason cited for this is that pension funds are increasingly pursuing a so-called 'barbell' investment strategy, whereby they are moving away from medium-risk strategies, and holding a portfolio of higher risk/return assets (hedge funds) and low-risk assets (bonds) to hedge their pension liabilities. Such investment strategies have grown in recent years as headline pension deficit measures have worsened due to compressed long-term interest rates.⁽²⁾

(1) Hedge funds traditionally structure their fees on a '2 and 20' basis, which means managers charge a flat rate of 2% of total asset value as a management fee, and an additional 20% on any profits earned.

(2) See Pension Protection Fund (2017), page 17.

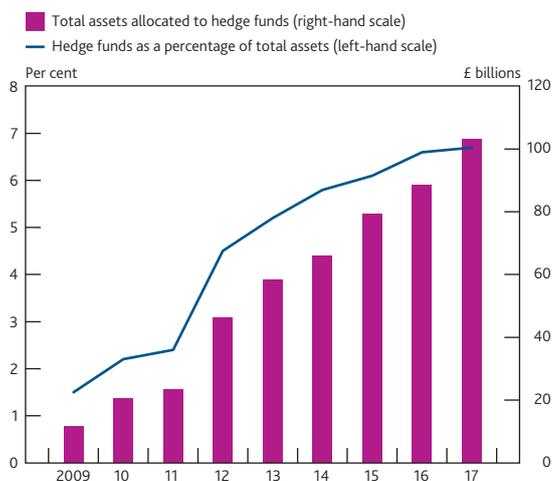
Figure 2 Hedge fund strategies, as a percentage of global hedge fund AUM (2017 Q3)^(a)



Sources: BarclayHedge and Bank calculations.

(a) Includes BarclayHedge data on both the Hedge Fund and CTA industries.

Chart 2 UK defined-benefit pension fund investment in hedge funds



Sources: *The Purple Book 2017* Pension Protection Fund and Bank calculations.

How do hedge funds finance their investments?

In order to implement their strategies effectively, hedge funds need to be able to borrow both cash (to take long positions) and securities (to short-sell). Hedge funds use two key methods in this manner to finance their investments: margin financing and repo.⁽¹⁾

Margin financing

To finance positions in equities and high-yield corporate bonds, hedge funds tend to use the securities lending and margin loan facilities of their prime brokers (known as margin financing). Securities lending is the temporary transfer of financial securities, such as equities and bonds, from a lender to a borrower. A margin loan involves the prime broker

lending hedge funds cash, secured against collateral. Margin financing is the preferred source of financing of equity and distressed debt funds, since they invest heavily in equities and corporate bonds.

Repo

To finance positions in government bonds, hedge funds tend to borrow in the form of repurchase (repo) agreements. Repo is essentially a secured loan. An institution borrows cash by selling an asset, for example a government bond, which it later repurchases at a prearranged price. Similar to margin financing, repo enables hedge funds to take long positions (by lending cash) and short positions (by lending securities). Repo is the preferred source of financing for funds that invest heavily in government bonds, such as relative value and global macro funds. According to the HFACS, over 90% of all repo lending by prime brokers to hedge funds is secured against government bonds.

Recent information suggests that a growing proportion of global repo lending may be transacted outside of the twelve firms surveyed in the HFACS. For example, the Bank's Market Intelligence suggests that Canadian and Chinese banks are increasing their repo market share.

How much leverage do hedge funds use?

As previously noted, leverage involves the use of financial borrowings and derivatives to take on financial exposures that are greater than a fund's capital. Using leverage, hedge funds

(1) Hedge funds do also use some other forms of financing, such as 'agency lending'. This is the practice of asking a third party to make the repo transaction, and offering them a guarantee against any gap between the collateral and cash values.

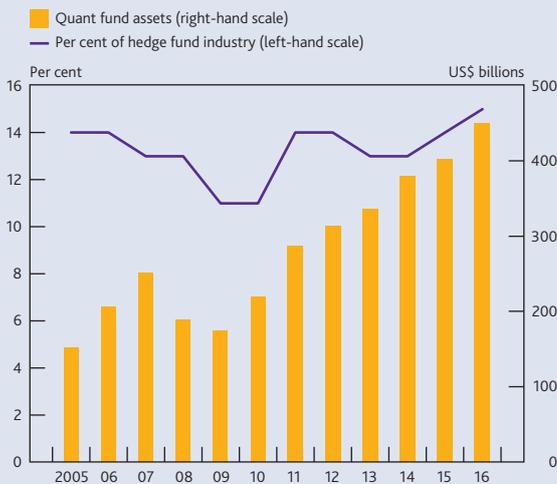
Quant funds

Quantitative or systematic hedge funds (known as 'quant funds') are typically funds where investment decisions are rules based rather than at the day-to-day discretion of the fund manager. Quant funds follow a variety of different investment methods and are active across a number of asset classes. Examples include so-called momentum or trend-following strategies; efforts to systematically exploit arbitrage opportunities between typically correlated securities; and so-called equity market neutral, which rely on data to take long and short positions in stocks.

Growth and innovation

In recent years quant funds have grown in popularity with investors. The quant fund sector is estimated by some to have had US\$450 billion in assets under management (AUM) in 2016, or 15% of hedge fund assets (Chart A). Since 2013, quant fund AUM is estimated to have grown at almost 10% per year, while the wider hedge fund industry appears to be growing at 6.4%.⁽¹⁾

Chart A The growth of quant fund assets^(a)



Source: Barclays Capital.

(a) Data include equity market neutral, equity directional, managed futures and quant multi-strategy funds.

This demand has been driven by a variety of factors. Most notably, typical 'active' fund managers have underperformed in recent years, and investors have turned to quant funds as a source of new, diversified returns. Alongside this, market contacts suggest that investors have become more comfortable with algorithmic or model-based strategies over time.

This influx of new money — as well as competition from cheaper, passive alternatives — has driven quant fund managers to innovate and differentiate themselves. Examples include the use of 'big data' and machine learning (particularly unsupervised machine learning)⁽²⁾ to source new strategies.

Some have also expanded into new, sometimes less liquid, asset classes such as fixed income or emerging market equities.

Fragilities and transmission channels

Quant funds tend to be more leveraged than their discretionary counterparts. This is perhaps unsurprising, given their focus on exploiting small pricing anomalies between assets rather than taking directional positions. For example, 'equity quant market neutral' strategies tend to be around 4x–5x leveraged, compared to an average financial leverage of 2x for the broader industry (as shown in Section 1). But, like many quants, these strategies tend to operate in the most liquid asset classes and hence are less likely to struggle to reduce their positions during stress.

Some market contacts have expressed concerns that quant funds (and similar rules-based investment offerings) may be more likely than discretionary managers to take crowded positions or exhibit a tendency to 'herd'. If a number of strategies are following similar rules or responding to similar signals, this could mean that small losses could lead to a large-scale reduction in positioning with potential broader spillovers. The 'quant crash' of August 2007 is one such example.

On the other hand, other contacts assert that there is little evidence of crowding currently with many hedge funds having basically no correlation with each other's performance. Another mitigating factor is that a number of bank 'proprietary' trading desks, which ran similar strategies in 2007, have been wound down since the crisis. These investors also exited their positions at the same time amplifying hedge fund losses during the quant crash.

The 'quant crash' of 2007⁽³⁾

In the years leading up to 2007, quant strategies experienced large inflows (Chart A), including from large multi-strategy funds that also traded in riskier assets such as subprime loans. When mortgage assets began to experience losses in 2007, at least one of these multi-strategy funds was forced to unwind their portfolios and sell off their most liquid securities — the equities in their quant portfolios.

This sell-off caused the prices of these assets to fall and led to losses for quant funds. As these losses became meaningful, more funds were also forced to unwind their books, yielding additional price impact that led to further losses, more deleveraging and so on (see Figure 3). The crowding in quant positions ultimately meant this feedback loop led to the failure of a number of funds, and substantial losses for others.

(1) Data based on Barclayhedge and Barclays (2017) research piece 'Rise of the Machines'.

(2) Unsupervised machine learning is closely aligned with what some people call 'true' artificial intelligence. It involves a computer learning to identify complex processes and patterns in data without a human to provide any guidance.

(3) See Khandani and Lo (2008).

are able to enhance their returns and take advantage of small mispricing opportunities. Leverage can also, however, magnify losses. It is often expressed as the ratio between total financial positions and capital. For example, if a hedge fund were to have total financial positions of US\$100 million but only US\$50 million of capital, their leverage ratio would be 2x. In this example, if prices were to decrease by 50%, the hedge funds capital would be entirely depleted. But leverage is usually not so straightforward to measure, especially when derivatives are involved.

While leverage differs from fund to fund, research has shown that broad changes in hedge fund leverage can be predicted through economy-wide variables rather than fund-specific factors. In particular, decreases in funding costs and increases in asset prices predict increases in leverage.⁽¹⁾

As part of its 2017 annual assessment of financial stability risk and regulation beyond the core banking sector, the FPC has asked for an in-depth assessment of the role of leverage in the non-bank financial system, especially leverage created through non-banks' use of derivatives.⁽²⁾ This will examine measures of leverage, its use and distribution throughout the non-bank financial system, and assess associated financial stability benefits and risks. The assessment will also support related international work, focused on the development of consistent measures of leverage in the fund sector.⁽³⁾

Financial leverage

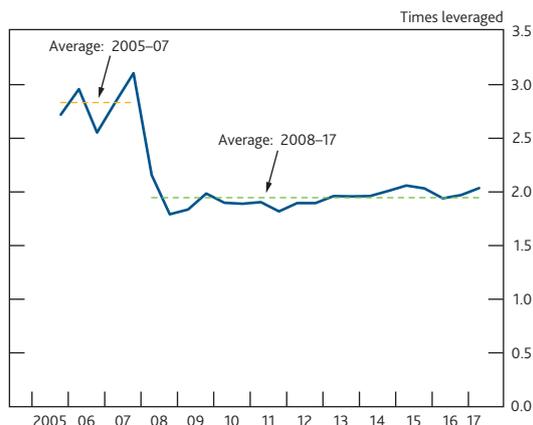
Hedge funds can obtain 'financial leverage' from their prime brokers, in the form of securities lending, margin loans and repo.

According to the HFACS, the gross financial leverage hedge funds currently take through prime brokerage is 2x. This means that hedge funds, in aggregate, have gross (absolute value of long and short) financial positions twice the size of the capital they post with their prime brokers.⁽⁴⁾ Financial leverage has stayed broadly flat since 2009, around two thirds of its level immediately pre-crisis (**Chart 3**).

Synthetic leverage

Hedge funds can also obtain leverage indirectly by using derivatives, which is known as 'synthetic leverage'. These contracts require the borrower to post initial margin, which is some percentage of the notional value⁽⁵⁾ of the contract. For example, a hedge fund buying a contract with a notional value of £100,000 may be asked to post 10% initial margin (£10,000). Under a simple measure (ie the ratio of notional value to the initial margin), this would give the hedge fund synthetic leverage of 10x. According to the 2015 FCA Hedge Fund Survey,⁽⁶⁾ hedge funds have an average (mean) synthetic leverage of 27x. Leverage can be measured in a number of more complex ways, and a suite of leverage measures is necessary to capture the full range of associated financial

Chart 3 Gross financial leverage taken by hedge funds via prime brokerage^(a)



Sources: Hedge Fund as Counterparty Survey and Bank calculations.

(a) Gross financial leverage equals absolute value of long and short positions taken through prime brokerage as a multiple of equity posted in prime brokerage accounts.

stability risks — for example, the notional value alone is likely to overestimate the potential market risk associated with a derivative contract.

Do certain types of hedge funds use more leverage?

Behind aggregate measures, such as those shown in **Chart 3**, there are significant differences between the amounts of leverage used by different hedge funds. The amount and type of leverage employed depends on the strategies the hedge fund follows. Strategies, such as fixed-income arbitrage, that are designed to position for the correction of relatively small market anomalies, often tend to require funds to take on the most leverage to achieve suitable returns. Quant funds also tend to take relatively higher levels of financial leverage (see the box on page 5), and global macro funds traditionally take higher levels of synthetic leverage. A commonality among most strategies that take higher leverage is the fact that the markets they operate in are generally considered to be highly liquid. In normal market conditions this allows hedge funds to rapidly adjust their exposures.

Measuring leverage

No individual measure of leverage perfectly captures the risks associated with being leveraged. To address this, in January 2017, the Financial Stability Board (FSB) published recommendations to address structural vulnerabilities relating to asset management activities.⁽⁷⁾ This included a recommendation that authorities (led by IOSCO) should by end-2018 develop better measures of fund leverage (for all

(1) See Ang, Gorovyy and van Inwegen (2011).

(2) See Bank of England (2017), page 54.

(3) See Financial Stability Board (2017a).

(4) This only refers to the capital hedge funds hold in their prime brokerage accounts, which differs from their total balance sheet capital.

(5) The amount of the underlying asset referenced by a derivative contract.

(6) See Financial Conduct Authority (2015).

(7) See Financial Stability Board (2017a).

International initiatives on hedge funds

A number of international initiatives have been set up to help understand and monitor risks in the hedge fund industry.

Financial Stability Board (FSB) Policy Recommendations to Address Structural Vulnerabilities from Asset Management Activities⁽¹⁾

In January 2017, the FSB published recommendations to address structural vulnerabilities relating to asset management activities.

In particular, leverage was one of the key vulnerabilities in asset management that was identified. The recommendations highlighted two key risks that warranted policy response: (a) the lack of consistent and available data on leverage; and (b) wide variation in limits imposed on financial and synthetic leverage across jurisdictions. As a result, the FSB included a recommendation that by end-2018, authorities (led by IOSCO) should identify and/or develop consistent measures of leverage in funds, to facilitate more meaningful monitoring of leverage.

European Systemic Risk Board (ESRB) expert group on Investment Fund Liquidity and Leverage⁽²⁾

This ESRB expert group is focused on leverage and liquidity risk in investment funds, including alternative investment funds, many of which can be categorised as hedge funds.

International Organization of Securities Commissions (IOSCO) Global Hedge Fund Survey

The IOSCO Global Hedge Fund Survey brings together data from a number of working group participants from around the world, including the United States, United Kingdom and more. The survey looks at the markets in which hedge funds operate, their trading activities, leverage, funding and counterparty information. It forms part of IOSCO's efforts to support the G20 initiative to mitigate risks associated with hedge funds.

This survey is published every two years. The most recent iteration of the survey was published in November 2017, using survey data from September 2016.⁽³⁾

Financial Conduct Authority (FCA) Hedge Fund Survey⁽⁴⁾

In their role as supervisor of hedge fund firms in the United Kingdom, the FCA collects data from hedge funds to inform their supervisory activity. The report outlines the key findings from their analysis of this data.

The most recent issue of this survey was June 2015. It has since been discontinued and replaced with the Alternative Investment Fund Managers Directive data.

(1) See Financial Stability Board (2017a).
 (2) See European Systemic Risk Board (2017).
 (3) See IOSCO (2017).
 (4) See Financial Conduct Authority (2015).

types of funds that use leverage, including hedge funds). For more information, see the box above.

How concentrated are prime brokers' exposures to hedge funds?

Exposures to hedge funds during the crisis were concentrated in the larger prime brokers, with the largest three prime brokers accounting for around 55%–65% of exposures (Chart 4). This declined following the crisis to around 40%. This supports market intelligence that hedge funds were spreading their financing across a greater number of prime brokers to mitigate counterparty credit risk (see Section 2).

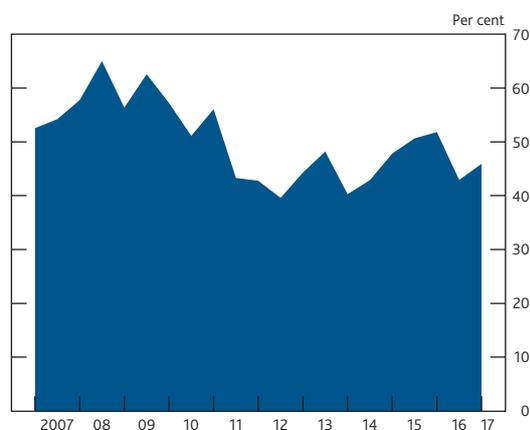
Growth of synthetics

Market contacts have suggested that the use of 'synthetic prime brokerage' has been increasing. Synthetic prime brokerage refers to the use of derivatives such as swaps to obtain exposure to an asset, in place of traditional cash/security lending. These swaps will allow the hedge fund to receive payments based on the return of an asset, in exchange for a set rate.

This growth is supported by the HFACS, which showed synthetic prime brokerage increasing from 12% of total

lending in 2013 to around 20% in 2015 (Chart 5). However, this trend does seem to have reversed somewhat in 2016.

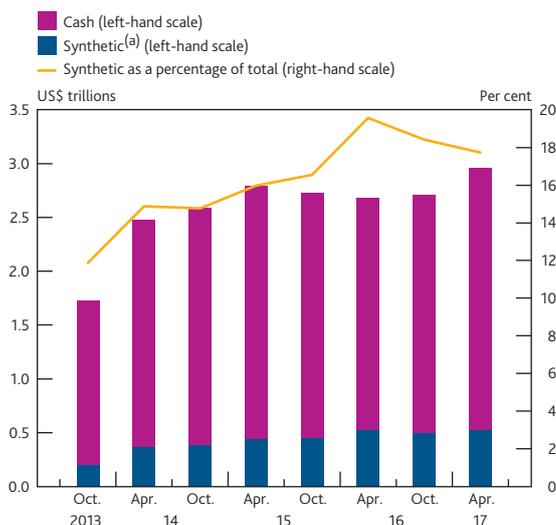
Chart 4 Largest three prime brokers share of total hedge fund potential exposures^{(a)(b)}



Source: Hedge Fund as Counterparty Survey.

(a) Firms are asked to calculate potential exposures as unsecured exposure plus a risk-related element. These exposures are then standardised to a 99% confidence interval over a ten-day holding period.
 (b) The composition of reporting in the survey has changed over time.

Chart 5 Notional value of synthetic and cash positions within prime brokerage



Source: Hedge Fund as Counterparty Survey.

(a) Any bilateral contract between a hedge fund and a prime broker which references a single stock or equity index producing a linear relationship (eg contract for difference or total return swap).

There are a number of reasons cited for this growth, with synthetic structures offering benefits to both hedge funds and the prime brokers. One reason suggested is the relatively different treatment of synthetic structures under certain regulation compared to traditional cash lending.

2 Potential financial stability risks from hedge funds

This section describes the ways in which hedge funds could affect financial stability and contribute to systemic risk,⁽¹⁾ and discusses how these risks may have been mitigated since the financial crisis. The framework guiding the analysis of financial stability — based on sources of fragilities and transmission channels of shocks — is similar to that used by the FSB in their shadow banking policy framework.⁽²⁾ In particular, this section considers:

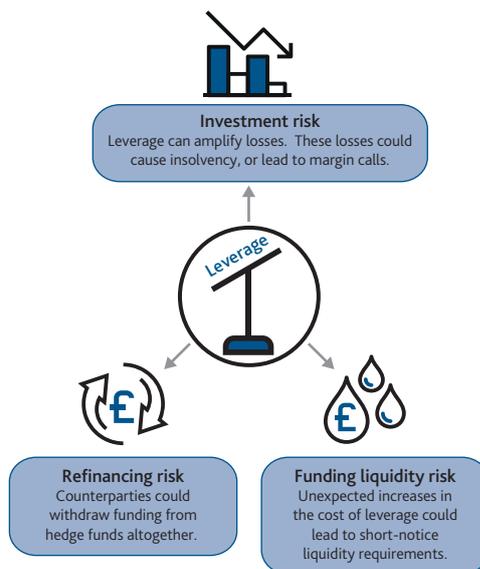
- (1) What risks do hedge funds face (**fragilities**)?
- (2) What are the ways that hedge funds could transmit risk into the wider financial system, or the real economy (**transmission channels**)?

What risks do hedge funds face?

Leverage

A key characteristic of hedge funds that can lead to their failure is their active use of leverage (**Figure 3**). First, leverage can amplify losses. Dependent on a fund's leverage ratio, these losses have the potential to be greater than a fund's capital, causing insolvency. Losses on positions can also lead to margin calls on derivative transactions. Since these margin

Figure 3 Potential risks of leverage in hedge funds



calls would require hedge funds to pay extra capital into their margin accounts, they could put stress on a hedge fund's cash holdings.⁽³⁾

Second, borrowing money to finance their positions means that hedge funds are exposed to any changes in the price of this borrowing. Such price changes could come in the form of larger haircuts⁽⁴⁾ on repo transactions, or increased initial margin on derivatives and secured lending. Leveraged hedge funds are exposed to the risk that initial margin requirements increase unexpectedly, creating a short-notice liquidity requirement, which would deplete their cash buffers.

Finally, as well as changing the terms on which they are willing to lend, counterparties could also withdraw funding altogether. If a fund has open trades that are not funded to maturity, this may require the rapid unwinding of positions.

Redemptions

Another source of risk is an unexpected rise in investor redemptions. During the 2008 financial crisis, many hedge funds faced redemptions from investors, as hedge funds had offered investors very favourable liquidity terms. Some of these hedge funds were forced to liquidate positions to meet

(1) For a discussion of systemic risk in hedge funds, see Lo (2008).

(2) See Financial Stability Board (2017b).

(3) In investing, buying on margin is the practice of buying an asset where the buyer only pays a percentage of the asset's value and borrows the rest. The amount the investor pays upfront is called the 'initial margin' and is calculated as a percentage of the initial value of the trade, whereas the maintenance margin is the minimum amount of equity that must be in this account at all times, calculated as a percentage of the current value of the trade. For example, if an asset cost US\$100 with an initial margin of 50% and a maintenance margin of 25%, the investor would have to post US\$50 upfront. Say the asset was to decrease in value to US\$60, this would mean the investor still owes US\$50, but only has US\$10 of margin in the account. Since the maintenance margin is 25%, that would mean the investor is under the minimum required equity (25% * US\$60 = US\$15). They would receive a 'margin call' forcing them to pay an extra US\$5 into the account.

(4) A repo haircut is the difference between the value of the cash lent and the collateral posted. It is normally expressed as the percentage deduction from the value of collateral.

investor redemption demands, and a number of funds were forced to close.

How has the hedge fund industry changed to mitigate these risks?

Since the financial crisis, there have been a number of changes that could help hedge fund resilience.

Reduction in financial leverage

As discussed in Section 1, the amount of financial leverage that hedge funds take via their prime brokers has reduced since the financial crisis. It has remained broadly flat since 2009 at around two thirds of its pre-crisis peak.

Margin locks

Hedge funds employ their own risk mitigation strategies to increase the stability of margin requirements. For example, many hedge funds agree margin 'locks' with their counterparties, which prevent prime brokers from increasing pre-agreed margin requirements for a specific period of time. According to the HFACS, over half of all funds' margin requirements with prime brokers are under some form of lock.

Investor 'lock ups' and notice periods

In an effort to protect themselves from investor redemptions, since the crisis hedge funds typically give their investors longer 'lock-up' periods. Lock ups refer to the amount of time after investment that investors are not allowed to redeem their money. By having longer lock-up periods, hedge funds mitigate liquidity risk caused via investor redemptions.

Relative to other types of funds, hedge funds also typically have longer notice periods, meaning investors have to give a certain amount of notice before they can redeem their money. For example, while mutual funds may offer daily redemptions, hedge funds often have notice periods of between 30 and 90 days.

IOSCO's 2017 Report on their Global Hedge Fund Survey⁽¹⁾ (see the box on page 7) suggests that hedge funds are well positioned to be able to meet investor redemptions through orderly liquidation of assets. In aggregate, surveyed hedge funds believe they can liquidate around 80% of their portfolio within 31–90 days, whereas only around 50% of funding could be removed in this time. This is known as a 'liquidity buffer'.

Less leveraged investors

In the early 2000s, institutional investors such as pension funds and endowments started allocating more capital to hedge funds. As a result, the proportion of capital in hedge funds associated with highly leveraged investors such as fund of funds⁽²⁾ and private banks was reduced. Furthermore, these institutional investors are largely considered more stable sources of capital.

Multiple prime brokers

Market contacts have reported that before the crisis many hedge funds used to use just one prime broker. But there has been a shift since the crisis towards using multiple prime brokers, which reduces hedge funds' counterparty credit risk. If a hedge fund considered one of its brokers to be getting weaker, under a multi-prime broker model they would be able to gradually shift their positions elsewhere. With just one prime broker, mounting prime broker default risk could cause uncertainty around whether the fund would be able to continue accessing financing.

How can hedge funds transmit risk into the broader financial system?

There are two key potential channels through which hedge funds could pose a threat to financial stability:

- (1) through risks to systemically important counterparties;
- (2) through risks to systemically important financial markets.

These transmission channels are shown in the **summary figure**.

(1) Risks to systemically important counterparties

Interconnectedness

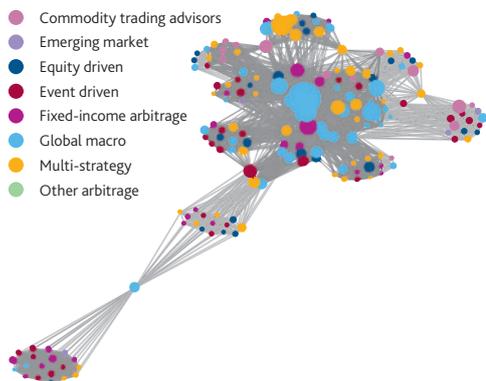
Hedge funds have the potential to be systemically relevant during crises due to their interconnections with other financial institutions, such as prime brokers. Hedge funds can transmit contagion to prime brokers, and, in turn, to other hedge funds also exposed to that prime broker.

Using data collected in the HFACS, it is possible to create a network where hedge funds are connected to each other when they have prime brokers in common. The survey only collects each prime broker's top 20 individual hedge fund exposures, so each hedge fund is indirectly connected to a minimum of 19 other hedge funds. In practice, however, they might be connected to a much larger number of hedge funds. The network derived from the HFACS is shown in **Figure 4**. It shows that there is a large cluster ('core') composed of highly interconnected hedge funds, and clusters of less interconnected hedge funds. A simple study of the network structure shows that the observed clusters are linked to specific prime brokers.

(1) See IOSCO (2017). Note that this report uses data from end-September 2016.

(2) Fund of funds are hedge funds that hold a portfolio of other investment funds, rather than investing directly in securities.

Figure 4 Visualisation of the network of hedge funds that arises through common prime brokers — April 2017^(a)



Source: Hedge Fund as Counterparty Survey.

(a) Different colours correspond to different investment strategies. The size of the nodes reflects total potential exposures as captured by the survey. Only based on top 20 hedge fund exposures for each prime broker.

Hedge funds in the core are serviced by more popular prime brokers, and other clusters by the remaining prime brokers. The size of the circles corresponds to hedge fund total potential exposures,⁽¹⁾ as captured by the HFACS.

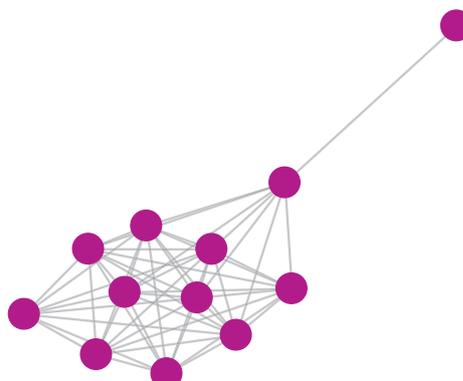
The identified clusters appear to be composed of hedge funds with a range of strategies, shown using different coloured discs (see Figure 2 for full list of strategies). This means that prime brokers in some sense have ‘diversified’ exposures to hedge funds. However, this does mean that even if hedge funds with different strategies are in theory exposed to different investment risks, they might be exposed to contagion through common distressed prime brokers.

Similarly, banks can be interconnected through their prime brokerage activities. Specifically, prime brokers are interconnected to each other through common hedge fund exposures. The corresponding network constructed using the HFACS is shown in Figure 5. Again, this is only based on each prime broker’s top 20 hedge fund exposures.

All but one of the prime brokers have multiple connections to other prime brokers. On average, each prime broker is interconnected to between 70% and 80% of the other prime brokers in the network. This supports the market intelligence mentioned in Section 2 suggesting hedge funds are spreading their exposures across multiple prime brokers.

If a market is particularly concentrated in a small number of firms, the failure of these firms has the potential to be extremely disruptive to a large number of market participants.⁽²⁾ Hence, the observed shift to a multi-prime broker model may be mitigating this concentration risk. On the other hand, this multi-prime broker model could increase contagion across prime brokers. For example, losses could spread through prime brokers were one or more of their

Figure 5 Visualisation of the network of prime brokers that arises through common hedge funds as counterparties — April 2017^(a)



Source: Hedge Fund as Counterparty Survey.

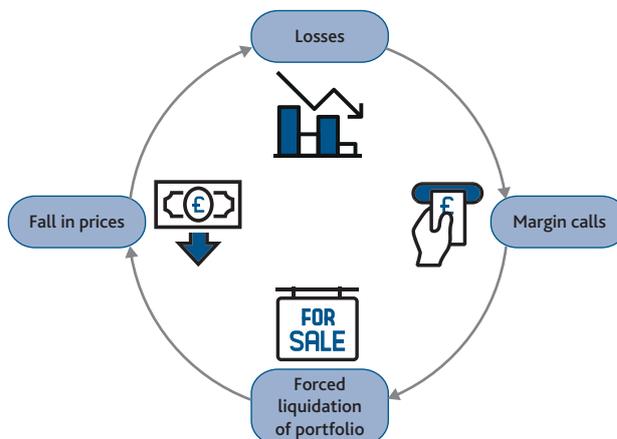
(a) Only based on top 20 hedge fund exposures for each prime broker.

common hedge funds to encounter stress, rather than being localised in one firm.

(2) Risks to systemically important financial markets
Proccyclical behaviour

Due to their relatively high levels of leverage, some hedge funds may come under pressure to act ‘proccyclically’ during periods of stress. This means that, following losses, they may be forced to liquidate positions to meet margin calls.⁽³⁾ By exiting positions, the hedge fund may place further downward pressure on falling prices. This in turn could lead to further margin calls on other institutions holding these assets, creating the potential for a feedback loop to develop (Figure 6).

Figure 6 Margin/price feedback loop



(1) Firms are asked to calculate potential exposures as unsecured exposure plus a risk-related element. These exposures are then standardised to a 99% confidence interval over a ten-day holding period.
 (2) This risk is particularly relevant in ‘fast markets’, which is discussed further in Bank of England (2017), page 49.
 (3) See footnote 3 on page 8 for a description of margin.

This feedback loop is exacerbated when a large number of funds operate highly correlated portfolios (and thus hold similar assets). An example of such a risk crystallising is the 2007 'quant crash' (see the box on page 5).

Importance to liquidity

Hedge funds only hold a small proportion of existing financial assets, but they tend to trade those very actively. For example, in aggregate, hedge funds turn over their portfolio over ten times a year and are 2x leveraged on a financial basis. This combination means that the importance of hedge funds to market functioning is likely to be higher than implied by their US\$3.5 trillion assets under management.

This importance to market liquidity could cause large-scale hedge fund closures to have adverse impacts on ordinarily liquid financial markets.

How has the financial system changed to mitigate these risks?

Derivatives

A large proportion of hedge fund exposures to their counterparties are via the derivatives market. Derivatives have the potential to create complex and opaque interconnectedness in the financial system, potentially amplifying shocks to financial stability. This was particularly evident during the financial crisis where a large and complex web of largely uncleared over-the-counter (OTC) derivative exposures was undercollateralised, undercapitalised and opaque to participants and authorities.

Following the crisis, G20 leaders agreed a series of reforms to global OTC derivatives markets to mitigate systemic risk and improve transparency. First, the proportion of OTC derivatives that are centrally cleared has increased markedly. The percentage of outstanding single-currency OTC interest rate derivatives that are centrally cleared globally has increased from an FSB estimate of 24% in 2008 to 62% in June 2017. Greater central clearing of transactions reduces counterparty credit risk and simplifies the network of exposures. Second, for those derivatives which are not centrally cleared, mandatory margin requirements have begun to be introduced to mitigate counterparty credit risk for uncleared trades. Finally, participants are now forced to report derivative transactions to authorities. This increases the transparency of the market to authorities.⁽¹⁾

Secured lending

The amount of margin that prime brokers require their hedge fund clients to post has increased markedly. According to the HFACS, since 2007, the amount of initial margin that banks require hedge funds to post in their prime brokerage accounts has increased in aggregate from around 17% of gross positions to around 30%.

In part reflecting the impact of these reforms, banks' aggregate potential exposures to the hedge fund industry are limited. According to the HFACS, in April 2017, none of the surveyed firms had aggregate potential exposures to hedge funds greater than 7% of their Tier 1 capital.

Banking resilience

Since the financial crisis, a number of reforms have been introduced in the banking sector to: increase capital; reduce leverage; and decrease liquidity risk. As a result, the banking system is now far better equipped to cope with any shocks from the hedge fund industry.

Proprietary trading

Prior to the financial crisis, hedge fund failures had the potential to be particularly problematic as large investment banks often held similar positions to hedge funds on their 'proprietary' trading books. This activity referred to banks investing in financial markets for their own accounts rather than on behalf of clients. The existence of these desks meant that any fallout such as the margin/price spiral mentioned above directly impacted the banking system. Increased financial regulation in the wake of the financial crisis has meant that most large banks have since wound down their proprietary trading desks (see the box on page 5).

Forthcoming reforms

Some reforms and regulatory efforts are still forthcoming, and plan to be rolled out in the near future. IOSCO's work on leverage that is discussed in Section 1, for example, is set to be published in end-2018.

Conclusion

Hedge funds are a growing part of the financial system, and their activity in financial markets mean they are important for secondary market liquidity and price discovery. Hedge funds typically finance their activities via banks' prime brokerage services which provide financing via secured financing, repo transactions and through derivative agreements. Some hedge funds are significant users of leverage, the extent to which is often dependent on the investment strategy they follow.

Hedge funds are exposed to a number of risks, some of which stem from their use of leverage, or liquidity risks from potential investor redemptions. Hedge funds can also potentially amplify shocks to the real economy, primarily due to their interconnectedness with other entities in the financial system. Since the financial crisis, a number of changes have been made which may serve to mitigate these risks. Business model changes by the hedge funds such as increased use of 'locks' and notice periods have reduced redemption risk, while

(1) For a more in-depth discussion of post-crisis derivative reforms, see Bank of England (2017), page 57.

international regulation such as the derivatives reform have reduced risks from interconnectedness created by hedge fund activities.

Since the financial crisis, prime brokers have also adapted their business models. For example, there has been growth in the use of 'synthetic prime brokerage' where derivatives are used

in place of cash/security lending. This could be due to the relatively different treatment of synthetic structures under certain regulations. Banks remain material counterparties to hedge funds, but the Hedge Fund as Counterparty Survey suggests that no prime broker has exposures to hedge funds greater than 7% of their Tier 1 capital.

References

Ang, A, Gorovyy, S and van Inwegen, G (2011), 'Hedge fund leverage', *Journal of Financial Economics*, Vol. 102, Issue 1, pages 102–26.

Bank of England (2017), *Financial Stability Report*, November, available at www.bankofengland.co.uk/financial-stability-report/2017/november-2017.

Barclays (2017), 'Rise of the Machines: landscape and recent developments in quantitative Hedge Fund strategies, products and managers'.

European Systemic Risk Board (2017), 'ESRB organisational chart', October, available at www.esrb.europa.eu/shared/pdf/Organisational-Chart.pdf.

Financial Conduct Authority (2015), 'Hedge Fund Survey', June, available at www.fca.org.uk/publication/data/hedge-fund-survey.pdf.

Financial Stability Board (2017a), 'Policy recommendations to address structural vulnerabilities from asset management activities', available at www.fsb.org/2017/01/policy-recommendations-to-address-structural-vulnerabilities-from-asset-management-activities/.

Financial Stability Board (2017b), *Global Shadow Banking Monitoring Report 2016*, available at www.fsb.org/2017/05/global-shadow-banking-monitoring-report-2016/.

IOSCO (2017), *Report on the Fourth IOSCO Hedge Funds Survey*, available at www.iosco.org/library/pubdocs/pdf/IOSCOPD587.pdf.

Jeffery, R, Lindstrom, R, Pattie, T and Zerzan, N (2017), 'The Bank's Market Intelligence function', *Bank of England Quarterly Bulletin*, Vol. 57, No. 1, pages 18–24, available at www.bankofengland.co.uk/-/media/boe/files/quarterly-bulletin/2017/the-banks-market-intelligence-function.pdf.

Khandani, A and Lo, A (2008), 'What happened to the quants in August 2007?: evidence from factors and transactions data', *NBER Working Paper No. 14465*.

Lo, A (2008), 'Hedge Funds, Systemic Risk, and the Financial Crisis of 2007–08: written testimony for the House Oversight Committee Hearing on Hedge Funds', available at <https://papers.ssrn.com/sol3/papers.cfm?abstract-id=1301217>.

Pension Protection Fund (2017), *The Purple Book 2017*, available at www.pensionprotectionfund.org.uk/Pages/ThePurpleBook.aspx.