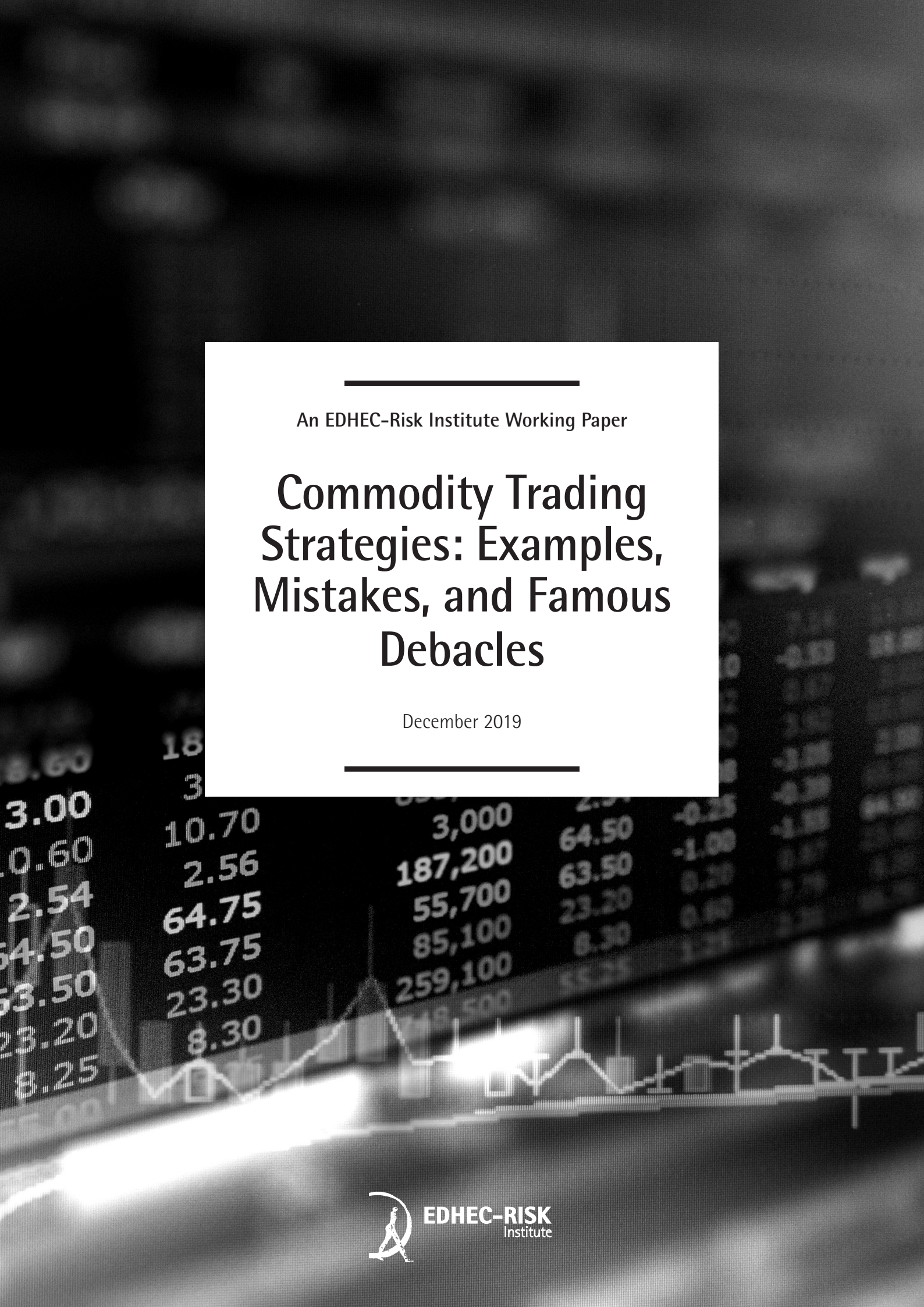

An EDHEC-Risk Institute Working Paper

Commodity Trading Strategies: Examples, Mistakes, and Famous Debacles

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The co-author of this paper, Ms. Hilary Till, presented this research at (1) ESSEC Business School's Energy and Commodity Finance Research Center (France) on June 12, 2017; (2) the Commodity and Energy Markets Conference at Oxford University on June 15, 2017; and at (3) a Cass Business School (City, University of London) Finance Research Workshop on June 16, 2017.

In addition, the analysis of the MF Global debacle was later referenced by Harvard Law School's Bankruptcy Roundtable, and some of the content of this working paper was also included in Till et al. (2018).

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Introduction

This paper provides a reasonably comprehensive tour of the always dynamic and frequently opaque commodity markets, including views on (1) commodity trading strategies, (2) common mistakes, and (3) two famous debacles. The specific types of commodity trading strategies that are included are trend-following and calendar-spread trading.

Commodity Trading Strategies

Although there are two basic types of Commodity Trading Advisors, discretionary and trend-following, the investment category is dominated by trend-followers. More than 70% of managed futures funds are estimated to rely on trend-following strategies. Trend-followers are also known as systematic traders. The operative word here is systematic. Automated programs screen the markets using various technical factors to determine the beginning or end of a trend across different timeframes. "The trading is based on the systematic application of quantitative models that use moving averages, break-outs of price ranges, or other technical rules to generate the buy and sell signals for a set of markets," explained Lungarella (2002).

As put forward by Rulle (2003), "A trend-following program may trade as many as 80 different markets globally on a 24-hour basis. Trend-followers try to capture long-term trends, typically between 1 and 6 months in duration when they occur." Trend-followers will scan the markets with quantitative screens designed to detect a trend. Once the model signals a trend, a trade will be implemented. Successful trend-followers curb losses on losing trades and let the winners ride. That is, they quickly exit false trends and lever into real trends, which is the distinguishing feature amongst trend-following CTAs. In a sense, alpha may come from this dynamic leverage. As Fung and Hsieh (2003) explained, "trend-following alpha will reflect the skill in leveraging the right bets and deleveraging the bad ones as well as using superior entry/exit strategies. Negative alphas will be accorded to those managers who fail to lever the right bets and show no ability in avoiding losing bets irrespective of the level of overall portfolio return – luck should not be rewarded."

One interesting aspect of trend-following CTAs is that each individual trade may have quite a small return relative to its volatility. But by combining numerous markets that are lowly correlated with one another, one has the advantage of the returns of each trade being additive while the overall portfolio's volatility is ever more dampened with the addition of each lowly correlated market. An AQR Capital Management white paper showed how persistent momentum profits have

Figure 1

Hypothetical Performance of Time Series Momentum						
Strategy performance after simulated transaction costs both gross and net of hypothetical 2-and-20 fees.						
Time Period	Gross of Fee Returns (Annualized)	Net of 2/20 Fee Returns (Annualized)	Realized Volatility (Annualized)	Sharpe Ratio, Net of Fees	Correlation to S&P 500 Returns	Correlation to US 10-year Bond Returns
Full Sample:						
Jan 1903 - June 2012	20.0%	14.3%	9.9%	1.00	-0.05	-0.05
By Decade:						
Jan 1903 - Dec 1912	18.8%	13.4%	10.1%	0.84	-0.30	-0.59
Jan 1913 - Dec 1922	17.1%	11.9%	10.4%	0.70	-0.12	-0.11
Jan 1923 - Dec 1932	17.1%	11.9%	9.7%	0.92	-0.07	0.10
Jan 1933 - Dec 1942	9.7%	6.0%	9.2%	0.66	0.00	0.55
Jan 1943 - Dec 1952	19.4%	13.7%	11.7%	1.08	0.21	0.22
Jan 1953 - Dec 1962	24.8%	18.4%	10.0%	1.51	0.21	-0.18
Jan 1963 - Dec 1972	26.9%	19.6%	9.2%	1.42	-0.14	-0.35
Jan 1973 - Dec 1982	40.3%	30.3%	9.2%	1.89	-0.19	-0.40
Jan 1983 - Dec 1992	17.8%	12.5%	9.4%	0.53	0.15	0.13
Jan 1993 - Dec 2002	19.3%	13.6%	8.4%	1.04	-0.21	0.32
Jan 2003 - June 2012	11.4%	7.5%	9.7%	0.61	-0.22	0.20

Source: Hurst et al. (2012), Exhibit 1.

been across time and across asset classes (Hurst et al., 2012). This is shown in Figure 1.

AQR constructed a simple momentum strategy as follows. They created "an equal-weighted combination of 1-month, 3-month, and 12-month momentum strategies for 59 markets across 4 major classes – 24 commodities, 11 equity indices, 15 bond markets, and 9 currency pairs – from January 1903 to June 2012," explained Hurst et al. (2012).

Excerpting further from the AQR authors' white paper: "Since not all markets have return data going back to 1903, ... [they constructed] the strategies using the largest number of assets for which return data exist[ed] at each point in time." They used "futures returns when ... available." And then "[p]rior to the availability of futures data," they used "cash index returns financed at local short rates for each country" as proxies for futures returns. Each position was sized to "target the same amount of volatility" and "positions across the three strategies ... [were] aggregated each month, and scaled such that the combined portfolio ... [had a] volatility target of 10%," explained Hurst et al. (2012).

In viewing Figure 1, Hurst et al. (2012) note that "[t]rends appear to be a pervasive characteristic of speculative financial markets over the long term." The AQR authors theorized that "price trends exist in part due to long-standing behavioral biases exhibited by investors, such as anchoring and herding, as well as the trading activity of non-profit seeking participants, such as central banks and corporate hedging programs."

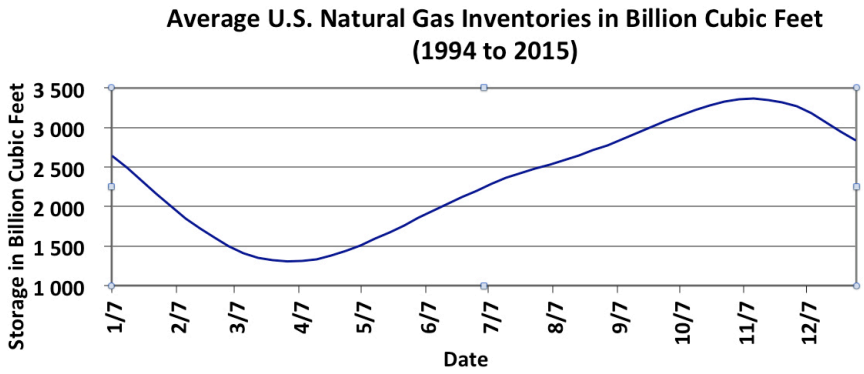
For further long-term evidence that momentum might be a structural characteristic of markets, one can consider a Federal Reserve Bank of Chicago working paper on equities that examined the profitability of momentum strategies in late Victorian-era England and during most of the past eight-and-half decades in the United States. Chabot et al. (2014)'s particular momentum strategies "earned abnormally high risk-adjusted returns ... between 1927 and 2012 [amongst U.S. equities] and [also] ... between 1867 and 1907 ... [amongst English equities]."

"However, the ... strategy also exposed investors to large losses ... during both [historical] periods," noted the Federal Reserve Bank of Chicago paper. Interestingly, "[m]omentum ... [losses] were [apparently] predictable." In both historical periods, losses were "more likely when momentum recently performed well." For the 1867 to 1907 period, losses were more likely when "interest rates were relatively low." And for the 1927 to 2012 period, losses were more likely when "momentum had recently outperformed the stock market". Each of these periods were "times when borrowing or attracting return chasing 'blind capital' would have been easier." The authors argue that the periodic large losses, associated with the strategy plausibly becoming too popular, "play an important role in sustaining" the momentum strategy's historical returns.

The Federal Reserve Bank of Chicago paper raises the question that a sizeable fraction of investors might not capture the documented, historical (but hypothetical) returns of momentum strategies since they may only enter the strategy after it has done well and then exit it once it has performed poorly. This explains why a strategy can potentially continue to exist, even if well known: investors may not be able to tolerate the periodic interim drawdowns, especially if they do not have a firm grasp on why a black-box strategy should be profitable.

In contrast to highly scalable CTA programs, proprietary futures traders often specialize in understanding the factors that impact the spread between two (or more) of a commodity futures contract's delivery months. These traders engage in calendar-spread trading. By way of further explanation, in all commodity futures markets, a different price typically exists for each commodity, depending on when the commodity is to be delivered. For example, with natural gas, a futures contract whose delivery is in October will have a different price than a contract whose delivery is in December. Accordingly, a futures trader may trade the spread between the October vs. December futures contracts. Calendar spread opportunities arise when a seemingly predictable one-sided commercial or institutional interest exists in particular futures

Figure 2



Sources of data: The Bloomberg and U.S. Energy Information Administration.

contracts: a proprietary trader will thereby take the other side of this "flow." Examples of one-sided flow have occurred during seasonal inventory build-and-draw cycles and also during the scheduled times when futures contracts are rolled in commodity indices. To the extent that commercial hedging activity causes trends in calendar spreads, a speculator can potentially have a profitable edge in taking the other side of these trades. Figure 2 shows the seasonal inventory build-and-draw pattern of natural gas from 1994 to 2015.

The prices of summer and fall futures contracts typically trade at a discount to the winter contracts. The markets thus provide a return for storing natural gas. An owner of a storage facility can buy summer natural gas and simultaneously sell winter natural gas via the futures markets. This difference is the storage operator's return for storage. When the summer futures contract matures, the storage operator can take delivery of the physical natural gas, and inject this natural gas into storage. Later when the operator's winter futures contract matures, the operator can make delivery of the physical natural gas by drawing physical natural gas out of storage for this purpose. As long as the operator's financing and physical outlay costs are under the spread locked in through the futures market, this operation will be profitable. Now to the extent that the hedging activity by storage operators causes trends in calendar spreads, a speculator can potentially have a profitable edge in taking the other side of these trades.

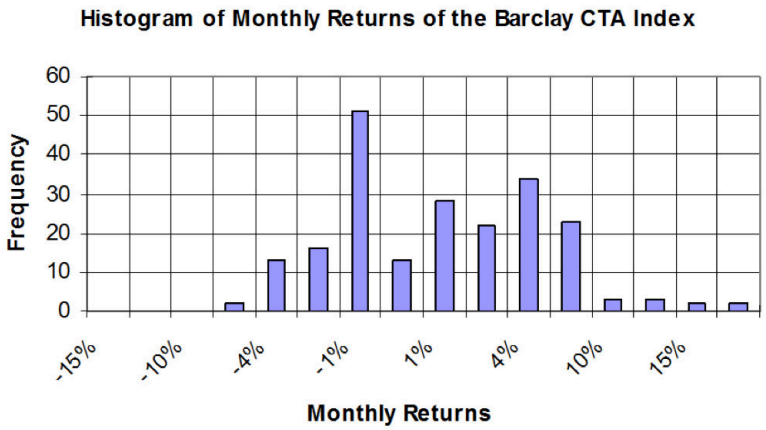
Another type of calendar-spread trading has arisen from commodity index rules. Commodity index rules specify when a particular index constituent should be sold and a further-maturity contract should be bought. In advance of such a procedure, speculators in some commodity futures contracts have historically sold the front-month while buying the next-month contract, establishing what is known as a *bear-calendar spread*. They would then unwind this position during index roll dates.

In examining the level of fees that funds are able to charge for moving the return distribution of an asset class to the right, one might conclude that investors highly prize positive skewness. Indeed, many investors expect long-options-like profiles from Commodity Trading Advisors and from global macro hedge fund managers. A long-options-like payoff profile is one where there is a truncated downside with the possibility of infrequent, but large gains, as shown in the chart in Figure 3 on the next page. Figure 3 is a histogram of historical CTA returns.

Figure 4 on the next page shows an example crude oil futures trading strategy that has a collar-like profile on crude oil futures returns. Collars are a combination option strategy of owning long out-of-the-money puts financed by selling out-of-the-money calls on an asset class that an investor owns. Figure 4 shows how, across quartiles of Brent oil futures returns, a particular trading strategy essentially gave up the possibility of very large returns in crude oil in exchange for avoiding quite negative returns on a Brent crude oil futures position.

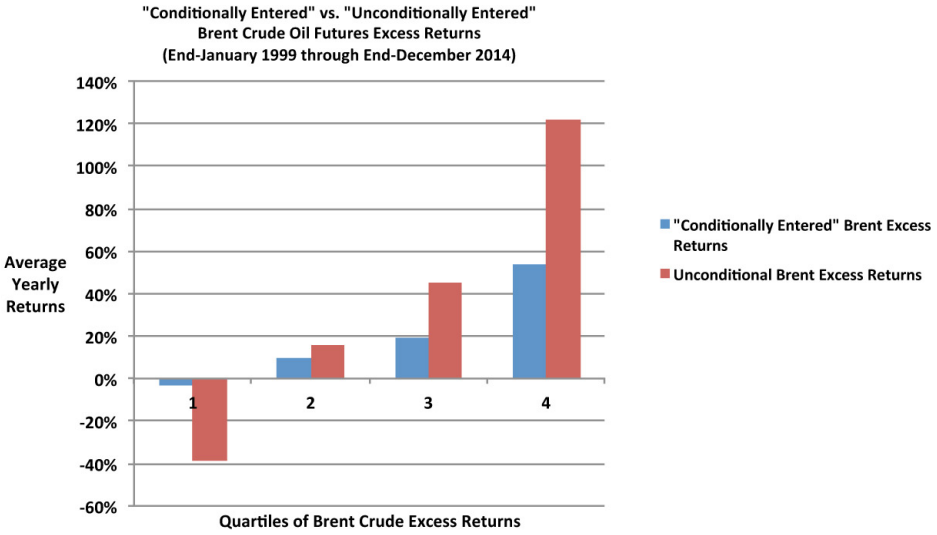
One typically finds that institutionally-scaled futures programs employ trend-following algorithms. Here, the key is employing such algorithms across numerous and

Figure 3



Source: Lungarella (2002).

Figure 4



Source of graphic: Till (2015).

diverse markets such that the overall portfolio volatility is dampened. In addition, investors in such programs are seeking pay-off profiles that are long-options-like. On the other end of the scalability spectrum are calendar-spread strategies. These strategies typically have limited scalability but individually can potentially have quite consistent returns.

Common Mistakes

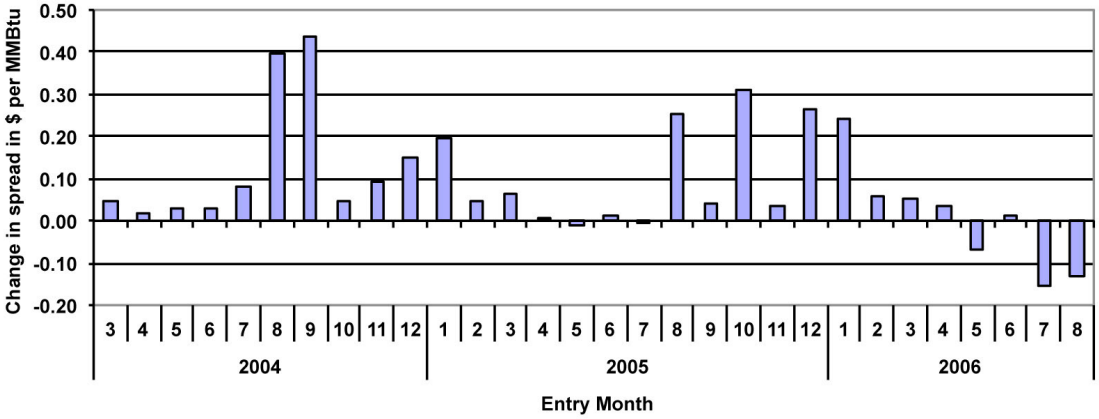
The second section of this paper covers three common mistakes in futures trading, which are (1) targeting absolute returns rather than risk; (2) establishing inappropriate sizing; and (3) having an inadequate appreciation for the need for psychological discipline.

The first mistake is targeting absolute returns rather than risk. If one does otherwise, the consequences can be disastrous. Figure 5 on the next page illustrates how consistent a strategy of trading natural gas using bear calendar spreads was between spring 2004 and spring 2006.

By early summer 2006, the profitability of this strategy had declined by about half of the performance of the previous two years. If commodity futures traders had responded by doubling up their position size to try to maintain an absolute-return target, then in July and August of 2006, they would have sustained losses about twice the size of the trader's year-to-date profits. The significance of such a loss is that when a trader's risk-and-return results differ dramatically from client and/or prime-broker expectations, this

Figure 5

Natural Gas Bear-Calendar Spread P/L, 1-Month Horizon, January 2004 through August 2006



can set off a critical liquidation cycle (De Souza and Smirnov, 2004.) In a critical liquidation cycle, client redemptions and/or additional demands for collateral from creditors cause a trader to liquidate positions in a distressed manner, which can then cause further losses that imperil a fund's survival, as both the fund's investors and creditors lose faith in the manager. Unfortunately, once a fund incurs a threshold level of losses, successive rounds of distressed liquidations will quickly cause a step-function decrease in the fund's net asset value.

Another mistake is inappropriate trade sizing. The size of the trade should be kept within a relatively small fraction of daily trading volume and open interest. The commodity markets do not have natural two-sided flow. For experienced traders in the fixed income, equity, and currency markets, this point may not be obvious. The commodity markets have nodal liquidity. If a commercial market participant needs to initiate or lift hedges, there will be flow, but such transactions do not occur on demand. Before a trader initiates a position, particularly one that is large compared to the size of the marketplace, one needs a clear understanding of what flow or catalyst will allow the trader out of a position. A commodity-market observer can readily identify when a massively-sized distressed liquidation is occurring, particularly in a spread market. If there is no economic or weather news regarding a market, and a spread relationship changes by many standard deviations relative to recent history, this is a clear signal that a market participant is unwinding a position in a distressed fashion. For example, on August 3rd, 2006, the market became aware that the hedge fund, MotherRock, was preparing to shut down because of terrible performance, based on a letter to the fund's investors from the hedge fund's founder.

Market participants, though, were already alerted to a distressed liquidation on August 2nd, 2006, the day before MotherRock's announcement. A near-month calendar spread in natural gas experienced a 4.5 standard-deviation move intraday before the spread market normalized by the close of trading on August 2nd, 2006.

Figure 6 on the next page illustrates the intraday and three-month behavior of the September-vs.-October Natural Gas spread on August 2nd. We might assume that MotherRock had on a position that was correlated to being short this spread. Why make this assumption? The brief intense rally in this spread on August 2nd, 2006 is consistent with the temporary effects of a forced liquidation, involving a position related to this spread. As it turned out, the scale of MotherRock's losses, which may have been up to $300 million, was small compared to the experience of the hedge fund, Amaranth, the following month.

Arguably, a third common mistake is an inadequate appreciation for the need for psychological discipline

when engaging in futures trading. One financial author has provided a challenge to other financial-market writers and presenters. This author of the book, Quantitative Trading and Money Management, has said that most financial literature is unrealistic. If financial articles were realistic, they would include *both* the joys *and* the tears of trading (Gehm, 2004).

In discussing the crucial elements of an investment process, this article has left out one vital aspect of trading, and that is a manager's *risk tolerance*. Vince (1992) states that monetizing market inefficiencies "requires more than an understanding of money management concepts. It requires discipline to tolerate and endure emotional pain to a level that 19 out of 20 people cannot bear. ... Anyone who claims to be intrigued by the 'intellectual challenge of the markets' is not a trader. The markets are as intellectually challenging as a fistfight. ... Ultimately, trading is an exercise in self-mastery and endurance."

Taleb (2001) has explained why it is a challenge for a manager to follow a disciplined investment process. He provided an example of a return-generating process that has annual returns in excess of T-bills of 15% with an annualized volatility of 10%. At first glance, one would think it would be trivial to carry out a trading strategy with such superior risk and return characteristics. But Taleb also notes that with such a return-generating process, there would only be a 54% chance of making money on any given day. If the investor felt the pain of loss say 2.5 times more acutely than the joy of a gain, then it could be potentially exhausting to carry out this superior investment strategy.

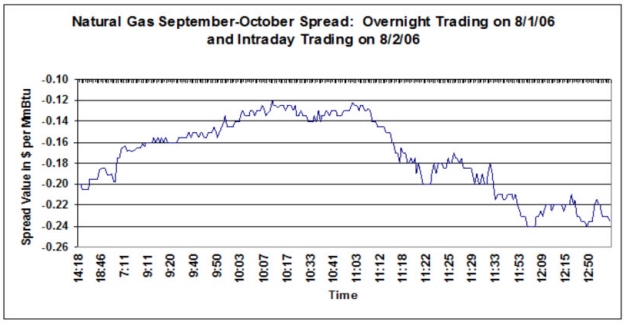
Famous Debacles

The following is a review of two well-known famous debacles, which occurred at the hedge fund, Amaranth, and at the Futures Commission Merchant, MF Global. The Amaranth case study will cover background on the hedge fund, its trading strategies, the fundamental rationale for its trading strategies, and also several risk analyses. The paper will also cover the hedge fund's operational risks, natural counterparties, the distressed unwind of its trading positions, and the legal proceedings against the hedge fund and its former head energy trader. The MF Global case study will provide some background on the lead-up and aftermath of the firm's demise, and what the lessons and reforms are from this debacle.

Amaranth

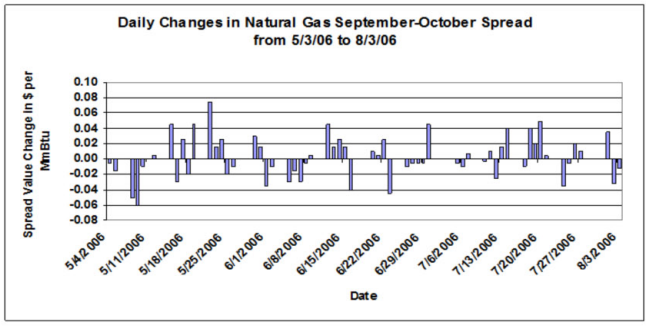
Amaranth Advisors, LLC was a multi-strategy hedge fund, headquartered in Greenwich, Connecticut, which eventually specialized in natural-gas derivatives trading. As of August 31st, 2006, the fund had about $9.2 billion in assets under management. On Monday, September 18th, 2006, market participants were made aware of Amaranth's distress. The founder had issued a letter to investors, informing them that the fund had lost an estimated 50% of their assets since its end-August value. Additionally, the fund had lost -$560 million on Thursday, 9/14/06 alone. By the end of September 2006, these losses amounted to $6.6

Figure 6



The intraday peak-to-trough move in the NG U-V spread was 12c on 8/2/06.

Trading in the NG U-V spread was discontinuous, so there are gaps in the graph when the spread did not trade.



As of 8/1/06, the daily standard deviation of the NG U-V spread had been 2.67c based on the previous three months of data.

Therefore, the spread's intraday move was 4.5 (= 12/2.67) standard deviations (based on the last three months of daily data.)

Source: Till (2006).

billion, making Amaranth's collapse the largest hedge-fund debacle to have thus far occurred.

What trading strategy had Amaranth employed to give rise to such massive losses? The fund had employed a natural gas spread strategy that would have benefited under a number of different weather-shock scenarios, but did so on a scale that still surprises market participants. Amaranth's core energy trading strategies were constructed through calendar spreads, which were executed on both the New York Mercantile Exchange (NYMEX) and on the Intercontinental Exchange (ICE). Amaranth's spread trading strategy involved taking long positions in winter contract deliveries and short positions in non-winter contract deliveries (Chincarini, 2007). These positions would have benefited from potential weather events such as hurricanes and cold-shocks from 2006 through 2011.

What was the fundamental rationale for Amaranth's positioning in being long winter vs. being short non-winter natural-gas contracts? In order to answer this question, one needs to provide some background on the U.S. natural gas market. Natural gas derivatives trading has offered hedge funds a potentially alluring combination of scalability and volatility, and also at times, pockets of predictability. Traders have been able to access these markets through the NYMEX for exchange-traded exposure or through the ICE for over-the-counter exposure. The key economic function for natural gas is to provide for heating demand during the winter in the northern states of the United States. Natural gas is also a key energy source for air-conditioning demand during the summer. There is a long "injection season" from the spring-through-the-fall in which natural gas is injected and stored in caverns for later use during the long winter season. Figure 7 shows the futures curve for natural gas as of September 26th, 2006.

One can note that the yearly futures curves for natural gas shown here mirror the average inventory build-and-draw pattern for natural gas, which was illustrated in Figure 2.

Why are natural gas spreads so volatile? It is only when a commodity is fully storable, that commodity spreads can be predictably stable. In that case, the determining factor between the value of one contract versus a later-month contract is the cost of storing and financing the commodity from one period to the next. In 2006, storage capacity for U.S. natural gas had actually declined since 1989 and domestic production had not kept pace with demand. These factors caused massive volatility in the outright price of natural gas and in the price relationships between different sectors of the natural gas curve. To give one an idea of natural gas' volatility, on September 26th, 2006, the implied volatility of one-month, at-the-money natural gas options was 92.5%. This was the case even though there were no hurricanes, heat-waves, or cold-shocks confronting this market at the time. There are reasonably short-horizon price-pressure effects in futures calendar spreads that are due to the seasonal hedging of inventories, including in natural gas. Amaranth was involved in these sorts of opportunities on a massive scale.

How could Amaranth's risk managers have gotten caught so wrong-footed? One explanation might be

Figure 7

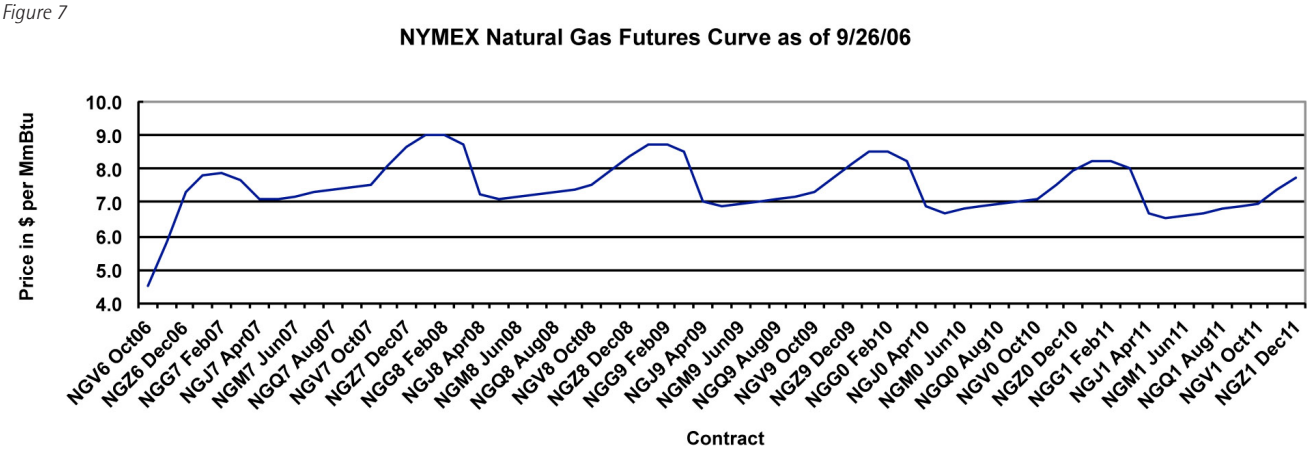


Figure 8

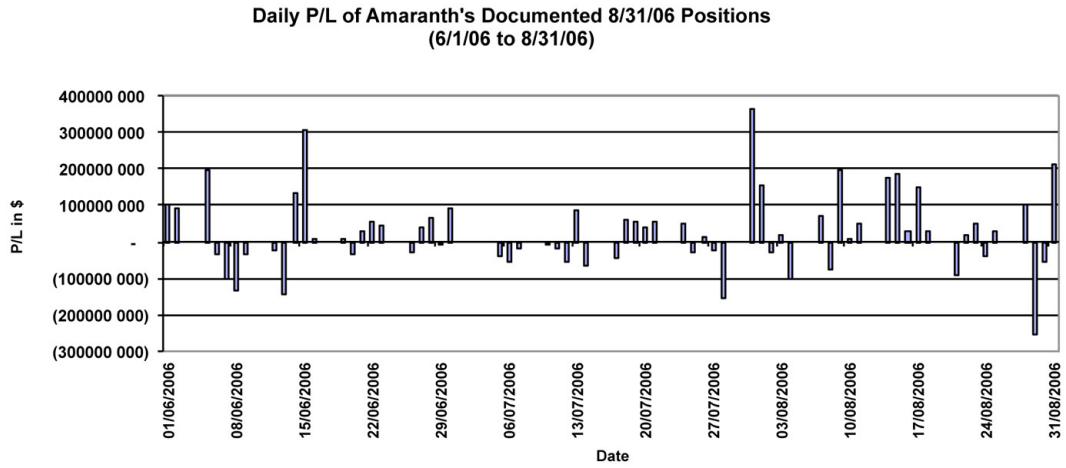


Figure 9

Scenario Analysis if Winter vs. Non-Winter Spreads Reverted to Past Spread Relationships							
Number of Contracts (105 620) 59 543	Spread Symbol NGV-X NGH-J	Natural Gas Spread Oct.-Nov. March-April	8/31/06 Level -2.18 2.14				
Date	NGV-X	NGH-J		Losses due to V-X	Losses due to H-J	Total Losses	Portfolio Loss
31/08/2000	-0.058	0.26		$(2 241 256 400)	$(1 119 408 400)	$(3 360 664 800)	-36.5%
31/08/2001	-0.33	0.09		$(1 953 970 000)	$(1 220 631 500)	$(3 174 601 500)	-34.5%
31/08/2002	-0.33	0.113		$(1 953 970 000)	$(1 206 936 610)	$(3 160 906 610)	-34.4%
31/08/2003	-0.25	0.44		$(2 038 466 000)	$(1 012 231 000)	$(3 050 697 000)	-33.2%
30/08/2004	-0.643	0.57		$(1 623 379 400)	$(934 825 100)	$(2 558 204 500)	-27.8%
31/08/2005	-0.185	2.24		$(2 107 119 000)	$59 543 000	$(2 047 576 000)	-22.3%

that risk metrics using recent historical data would have vastly underestimated the magnitude of moves that can occur during an extreme liquidation pressure event. Figure 8 shows the daily p/l of Amaranth's August 31st, 2006 positions. These positions were documented in a 2007 U.S. Senate report.

Now, Amaranth's positions did change over the summer of 2006, so the intention of the graph in Figure 8 is not to show the fund's actual p/l over this period. Instead, the intention of the graph is to show what the typical volatility that Amaranth's risk managers might have expected from the portfolio, going into September 2006. The daily standard deviation of the August 31st, 2006 positions, based on three months of data, was about $105 million. But if the fund's risk managers had employed scenario analyses that evaluated the range of natural-gas-spread relationships that had occurred in the not-too-distant past, they would also have seen how massively risky the fund's structural position was in its magnitude.

As of August 31st, 2006, winter natural gas futures prices were trading at an extreme relative to non-winter-month contracts. A simple scenario analysis of the time would have been to examine over say, the previous six years, what the level of the fund's spreads had been. One could have then quickly evaluated what the potential losses could be if a normal state-of-the-world reappeared. In our scenario analysis, we examine the past spread values for positions that were highly correlated to Amaranth's portfolio in order to understand the riskiness of Amaranth's documented August 31st portfolio. If the two spreads that were highly correlated to Amaranth's portfolio had reverted to levels that had prevailed at the end of August during the previous six years, one could have seen that up to -36% could have been lost under normal conditions. This is illustrated in Figure 9.

Now, the best public information we have on the operational risks associated with an investment in Amaranth is from an essay by Fauchier Partners (Hosking, 2006). According to Fauchier Partners, they had inherited a $30-million position in the fund in 2005 in a portfolio that they had taken on from a competitor. "Following on-site meetings with ... [Amaranth's] founder and his team, ... [Fauchier] decided to redeem from the fund. Moreover, [they noted that their] ... concerns were sufficient to justify paying a redemption penalty for an early exit," noted Fauchier's co-founder. Amaranth had just about every characteristic that Fauchier avoided in a hedge fund.

As summarized in Hosking (2006), these characteristics included:

- "An apparent absence of sufficient risk controls;
- High leverage;
- Poor transparency;
- Performance heavily dominated by one strategy;
- Uncapped expenses in addition to management and performance fees;
- Annual re-set of the high water mark on performance fees;
- Self-administration (i.e., no independent third-party verifying returns);
- An in-house broker-dealer (which makes it possible to smooth returns);
- Individual traders who were not invested in their own books;
- Hubris amongst the management team; and
- Poor liquidity terms."

Fauchier believed that the case of Amaranth was "anything but unforeseeable." Rather, it was "a fund with bad risk management and unattractive terms for investors."

The natural counterparties to Amaranth's trades ultimately would have been the physical-market participants who had locked in the value of forward production or storage. The physical-market participants would likely have had physical assets against their derivatives positions so would have had little economic need to unwind these trades at Amaranth's convenience. We can infer how long it took to unwind the Amaranth positions by examining the footprints in natural gas spread relationships. It was not until the end of October 2006 that the natural gas curve stabilized, indicating a stop to the liquidation pressure by that time as illustrated in Figure 10 on the next page.

In August 2009, Amaranth agreed to pay $7.5 million to end U.S. cases brought by the Federal Energy Regulatory Commission and the Commodity Futures Trading Commission over price manipulation (Zajac, 2013). Five years later on September 15th, 2014, the former head natural gas trader at Amaranth agreed to pay $750,000 to settle a Commodity Futures Trading Commission lawsuit claiming he tried to rig prices of natural gas contracts (Van Voris and Hurtado, 2014).

MF Global

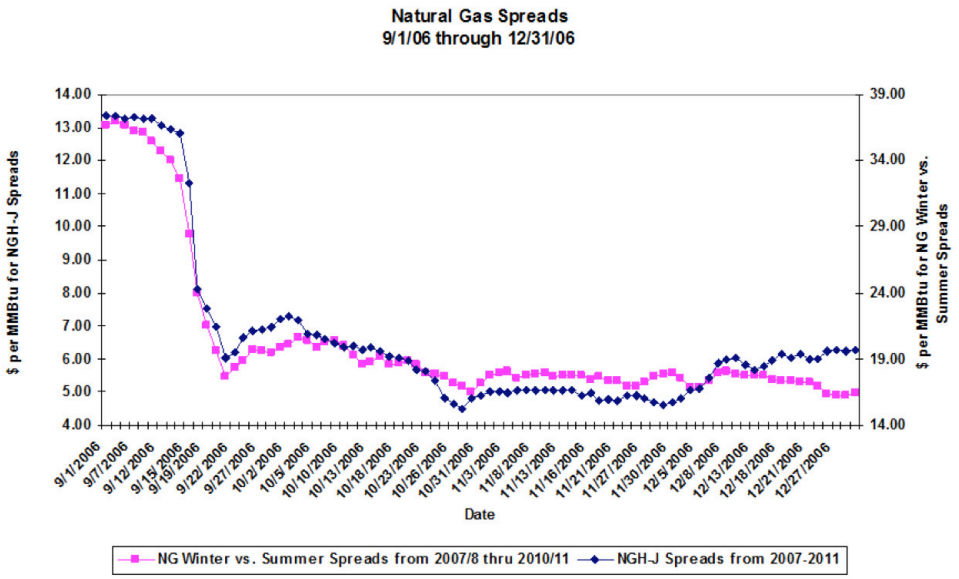
Futures market participants were caught off-guard when MF Global filed for bankruptcy on October 31st, 2011. Essentially, this episode educated industry participants that customer protections in the U.S. commodity futures markets had been more ambiguous than expected. That said, there are a number of reforms that have been undertaken to help prevent future MF Globals.

Before its bankruptcy filing, MF Global Holdings Ltd. provided execution and clearing services for:

- exchange-traded and OTC derivatives products,
- non-derivative foreign exchange products, and
- securities in the cash market.

The firm had a worldwide client base of 130,000 accounts and operated in 12 countries on more than 70 exchanges. Although a niche player on Wall Street, MF Global was a force on the Chicago Mercantile Exchange. MF Global had 3 million futures and options positions with a notional value of more than $100 billion. Its customers made up 28% of the trading volume on the CME. Prior to the firm's spin-out from its parent company in 2007, MF Global's business could be characterized as "dull normal." During the spin-out of MF Global (MFG), parent company Man Group burdened MF Global with (arguably) an enormous short-term debt load, relative to the firm's profitability. We can see how large this debt load was from one of

Figure 10



Source: Till (2007).
Note: "NGH-J Spreads" refer to the March-April Natural Gas calendar spreads.

Figure 11

MF GLOBAL LTD. NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Unaudited) (Dollars in thousands, except share data)		
Short-term borrowings consist of the following:	December 31, 2007	March 31, 2007
364-Day Bridge Facility	$1 400 000	$-
Other short-term borrowings	$400 000	
Bank overdrafts	73 672	25 453
Current portion of long-term borrowings		56 552
Total	$1 873 672	$82 005

Source: MF Global (2007).

Figure 12: Net Excess Regulatory Capital

MF Global Inc. (Formerly Man Financial Inc.)							
A/O Date	Adjusted Net Capital	Net Capital Requirement	Excess Net Capital	Customers' Required Segregated Funds*		Excess Net Capital / Customer Funds	
05/31/2007	$581 103 464	$402 913 253	$178 190 211	$8 384 461 426		2.1%	
06/30/2007	$605 217 511	$364 381 766	$240 835 745	$8 235 595 803		2.9%	
10/31/2007	$535 142 778	$427 261 012	$107 881 766	$9 929 407 496		1.1%	
11/30/2007	$645 473 966	$414 600 708	$230 873 258	$9 889 773 129		2.3%	
02/29/2008	$640 913 963	$509 842 535	$131 071 428	$13 007 347 859		1.0%	<-- 6th Lowest Ratio Amongst 151 FCMs
03/31/2008	$771 268 907	$417 502 089	$353 766 818	$9 684 866 771		3.7%	<-- 26% Drop in Customer Segregated Funds
05/31/2008	$782 299 749	$443 840 666	$338 459 083	$9 664 731 983		3.5%	
06/30/2008	$608 963 888	$456 329 713	$152 634 175	$10 566 911 049		1.4%	<-- On 6/13/08, company announces** plan to refinance $1.4 billion bridge loan. This includes using "excess funds."
08/31/2011	$495 665 616	$328 485 943	$167 179 673	$7 270 301 248		2.3%	

* These figures only include funds "required" to cover margins. As of February 2012, the CFTC also releases the total assets in customer accounts, according to Prezioso (2012).
** Source: MF Global (2008).
Data Source: The Commodity Futures Trading Commission (CFTC) monthly reports on "Financial Data for FCMs"

the company's financial statements that is available on the SEC website, EDGAR. See Figure 11.

The spin-out occurred just before the onset of the global financial crisis, making it uncertain throughout 2008 how the firm would be able to refinance its short-term debt. That said, MFG was eventually successful in doing so by the end of 2008. Also because of a rogue trader incident, the firm was in a precarious capital situation. We can see how weak the firm was relative to other FCM's from examining data available on the CFTC's website. As illustrated in Figure 12, MF Global was the 6th weakest Futures Commission Merchant amongst the 151 competing firms of the time.

MF Global's business model became in jeopardy during the compression of yields available in fixed-income investments. Note the table in Figure 13, which is excerpted from an MF Global financial statement that is accessible on the SEC website, EDGAR.

As a futures commission merchant, the firm had strongly relied on income from the investment of customer collateral for its profitability. A FCM is allowed to credit back to customers only a fraction of the income the FCM earns on customer collateral. The firm was profitable in 2007, but then lost money for the following 4 years. We can see also how dire the trend was for MF Global's profitability from the June 4th, 2012 MF Global Inc.'s bankruptcy trustee report. Figure 14 shows how dramatic the drop-off in interest income for MF Global was as short-term interest rates were set to near zero in the aftermath of the Global Financial Crisis. This chart covers the period, September 2007 through June 2011.

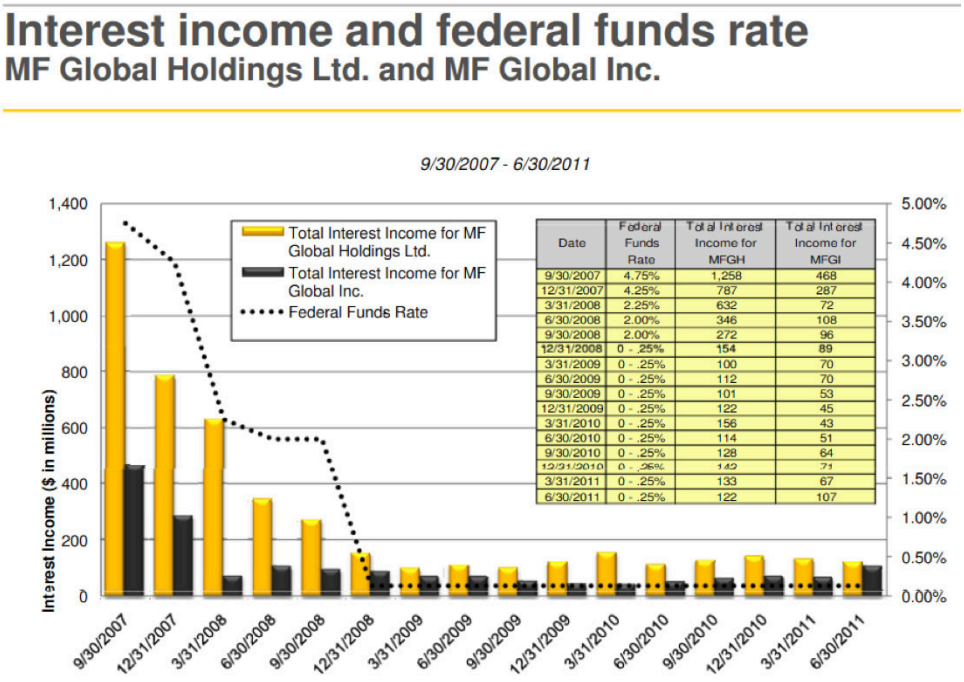
In 2010, MF Global hired Jon Corzine as its CEO. Corzine's background included a stint as the Chief Executive Office of investment banking and securities firm Goldman Sachs, and four years as the governor of New Jersey, as well as a partial term as U.S. Senator. Nonetheless, in Congressional testimony in December

Figure 13

YEAR ENDED MARCH 31,					
(Dollars in millions)	2011	2010	2009	2008	2007
Net (loss)/ income attributable to MF Global Holdings Ltd.	$(81.20)	$(137.00)	$(49.10)	$(69.50)	$188.00

Source: MF Global (2011).

Figure 14



Date	Federal Funds Rate	Total Interest Income for MFGH	Total Interest Income for MFGI
9/30/2007	4.75%	1,258	468
12/31/2007	4.25%	787	287
3/31/2008	2.25%	632	72
6/30/2008	2.00%	346	108
9/30/2008	2.00%	272	96
12/31/2008	0 - .25%	154	89
3/31/2009	0 - .25%	100	70
6/30/2009	0 - .25%	112	70
9/30/2009	0 - .25%	101	53
12/31/2009	0 - .25%	122	45
3/31/2010	0 - .25%	156	43
6/30/2010	0 - .25%	114	51
9/30/2010	0 - .25%	128	64
12/31/2010	0 - .25%	142	71
3/31/2011	0 - .25%	133	67
6/30/2011	0 - .25%	122	107

Source: Hughes Hubbard & Reed LLP, Attorneys for James W. Giddens, Trustee for the SIPA Liquidation of MF Global Inc. (2012b), p. 192.

2011, a few weeks after MF Global went bankrupt, Corzine admitted that he had little expertise or experience in the operational aspects of MF Global (Corzine, 2011). The CEO's plan was to eventually convert the futures broker into an investment bank, a near impossibility, especially given the firm's precarious capital situation and troubled business model. So the CEO's task became how to make the firm profitable as soon as possible. Corzine devised a strategy to enter into a large-scale, leveraged, proprietary trade on five peripheral European bond markets to attempt to ensure the firm's profitability in the face of a challenging environment for its business model. MF Global's exposure to the European bond market became larger than that of the exposure of Goldman Sachs and Morgan Stanley combined. This is shown in Figure 15.

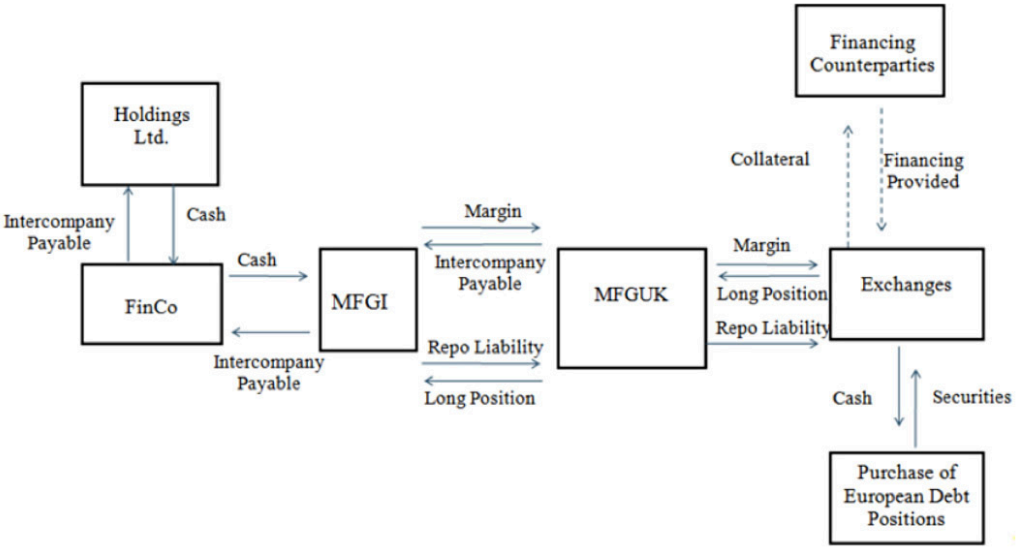
The structure of how MF Global was able to enter into this leveraged trade with such little capital is illustrated in Figure 16, which is drawn from MF Global Holdings Ltd.'s bankruptcy trustee report of April 4th, 2013.

Figure 15

Company	Stated Balance Sheet Exposure*	Exposure as a % of Q End Equity	Exposure as a % of Q End Assets	Quarterly VaR Average	VaR as a % of Q End Equity
MF Global (MF)	$6.4 B	460.6%	13.9%	$3.0 M	0.2%
Citigroup (C)	$13.5 B	7.7%	0.7%	$184 M	0.1%
Goldman Sachs (GS)	$1.9 B	2.6%	0.2%	$101 M	0.1%
Jefferies (JEF)	N/A	N/A	N/A	$12.7 M	0.4%
JP Morgan (JPM)	$14 B	7.7%	0.6%	$94 M	0.1%
Morgan Stanley (MS)	$2.0 B	3.4%	0.2%	$145 M	0.2%

**as measured under a firm's internal approach*
Source: Hughes Hubbard & Reed LLP, Attorney for JAmes W.Giddens, Trustee for the SIPA liquidation of MF Global Inc. (2012b), p89.

Figure 16: End-to-End Structure of MF Global's Euro RTM Transaction
This figure diagrams how MF Global carried out its leveraged European sovereign-debt trades, focusing on the various financing relationships in doing so.



Source: Morrison & Foerster LLP, Attorneys for the Chapter 11 Trustee (2013), p. 33.
Notes: "MFGI" is an abbreviation for MF Global Inc., "an indirect subsidiary of MF Global Holdings Ltd."
MFG UK is an abbreviation for MF Global U.K. Limited, which "was the MF Global entity that was a member of the clearinghouses in Europe."
The "Euro RTMs" were trades in European sovereign debt, which, in turn, were "financed through repurchase to maturity transactions."
"On the dates MFGI entered into the various Euro RTMs, it recognized a gain in the amount of the difference or spread between (1) the effective interest rate received by MF Global on the debt securities and (2) the repurchase rate (or the financing rate) paid by MF Global to the counterparty. MFG UK recognized a gain in the amount of the markup for its role as counterparty to both MFGI and the clearinghouses. The trades were held by MFGI so that it, rather than MFG UK, bore the risk of default or restructuring of the sovereign debt.
On July 1, 2010, MFGI and MFG UK entered into an investment management agreement related to the Euro RTM trades, which provided that MFG UK would identify market opportunities related to the sovereign debt of certain European governments. Pursuant to this agreement, MFG UK received 80% of the consolidated net revenue of such transactions, while MFGI received 20% of the revenue, held the trades, and took the risk that the sovereigns would default or restructure their debt."

The financing for purchasing the bonds was done through MF Global's U.K. subsidiary. U.K. law effectively allows more opportunity for leverage by broker-dealers than U.S. law, which is why the transaction was executed in London. The bond trade was also documented in MF Global U.K.'s Special Administrator report (KPMG, 2011). The rationale for executing this trade was that the interest rate offered by the short-term European bonds was much higher than their financing rate; and the bonds seemed to be good risks since they were backstopped by the European Financial Stability Facility, which in turn was financed by members of the Eurozone. The problem was that MF Global had very little capital to sustain any meaningful mark-to-market fluctuations.

Before the firm's downward liquidity spiral, the bond trade's mark-to-market materially improved MF Global's profitability, as shown by the MF Global Inc.'s trustee report of June 4th, 2012. But astonishingly, the firm did not have a plan for how to exit these trades if the firm became stressed and wouldn't be able to make margin calls. We know this from an MF Global Board of Directors' presentation from the summer of 2011. This report is available on the New York Times' website.

At the end of October 2011, in rapid succession, the firm experienced a credit downgrade and announced worst-than-expected earnings, leading investors, clients, and creditors to doubt the sustainability of the firm's business model. At that point, MF Global rapidly liquidated some of its European bond bet; attempted to meet additional margin calls that resulted from its ratings downgrade; and attempted to meet customer redemptions as clients left the firm en masse.

One interesting question from this case is as follows: how could a seemingly functional firm collapse in a week? This is the type of question that also comes up with the Bear Stearns and Lehman bankruptcies of 2008. Roe (2011) has argued that an aspect of the U.S. Bankruptcy Code provides the explanation. A bank may choose to provide repo financing for a weak counterparty since the bank is allowed to seize collateral quickly if the weak counterparty goes bankrupt, so the bank does not have to worry about the creditworthiness of the counterparty. Normally when a firm is going bankrupt, creditors cannot immediately seize assets because the effort is to protect the company so that it can reorganize successfully. Once banks lose confidence in a weak financial firm and quickly terminate repo financing, the weak firm spirals quickly into bankruptcy.

A second interesting question from this case is as follows: why in late October 2011 did the firm have worst-than-expected earnings? Its $186.6 million loss during the 3rd quarter of 2011 was its worst ever. The explanation here has to do with an aspect of U.S. accounting conventions. According to Worstall (2011) and Weil (2011), most of the loss came from writing down *deferred-tax assets*. "Basically this item represented the money MF [Global] had thought it would save on taxes in the future, assuming it would be profitable," wrote Weil (2011). When a company has losses, one can carry forward those losses, and net them against future profits, thereby paying less taxes in the future. This future ability to pay less taxes is counted as an asset: a deferred-tax asset. By writing off the firm's deferred-tax assets, that is basically admitting that there is no visibility for the firm to become profitable in the foreseeable future. In the earnings announced on Tuesday, October 25, 2011, MF Global wrote off its deferred-tax assets, which signaled that either the firm or its accountant did not see profitability on the horizon. The company's credit downgrade and worst-than-expected earnings immediately set off a liquidity crisis.

During later hearings before the U.S. Senate Banking, Housing, and Urban Affairs Committee in April 2012, Chicago Mercantile Exchange Executive Chairman Terrence Duffy pointed out that MF Global's bankruptcy trustee "had said that the company had a liquidity crisis, and their increases went from $200 million to $900 million on their margin calls. That money had to come from somewhere, and if there's a liquidity crisis, where was that money coming from?" On June 4, 2012, the MF Global Inc. bankruptcy trustee showed that MF Global had dealt with its liquidity crisis through using funds from futures customer accounts

(Hughes Hubbard & Reed LLP, 2012b). One week after MF Global's liquidity crisis began, in the morning of Monday, October 31, regulators lost confidence in the firm when it was unable to reconcile its books and satisfactorily explain a significant shortfall that had been discovered in the firm's customer segregated accounts. This shortfall was without precedent in the history of the futures industry (United States House of Representatives, 2012). A potential deal for another firm to buy MF Global collapsed, given the shortfall in customer segregated accounts.

On October 31st, MF Global's holding company declared bankruptcy under Chapter 11 of the Bankruptcy Code; and the Broker-Dealer/Futures Commission Merchant subsidiary was put into liquidation in a Securities Investors Protection Act proceeding. The legal procedures, though, which cover the liquidation of securities firms, can potentially be interpreted such that they conflict with the legal procedures that were designed for the bankruptcy of futures firms. Normally, a futures firm is put through another type of bankruptcy process where there are explicit procedures that are customized for futures firms. This was not done for MF Global. Again, the firm was put through a process designed for securities firms. That said, there is a credible body of law that futures customers should have priority over all other claimants. But it did take 5 weeks for the MF Global Inc. trustee to publicly verify this.

An inspector general report on the CFTC's actions was released on May 20th of 2013. One gets a sense of the shock that there was actually a shortfall in customer segregated accounts. Accordingly, it was only at about 5am on Monday, October 31st that a decision was made to put the company in bankruptcy and have a trustee become responsible for the company. Also, given that MF Global was regulated by so many different regulators, there was an enormous coordination problem amongst regulators during the firm's final weekend.

Within the United States, MF Global was regulated by the Securities and Exchange Commission as a broker-dealer and also by the Commodity Futures Trading Commission as a futures commission merchant. According to Collins (2012), the decision to put MF Global through a bankruptcy process that had been designed for securities firms "baffled futures industry participants who felt it would delay customers being made whole." Added Collins, "futures regulators in the past had gone to court to fight for jurisdiction when an asset freeze would be adverse to futures industry customers."

Starting on October 31st , 2011, MF Global customers' funds and futures positions were frozen on and off for days. Astonishingly, when the MFG bankruptcy was filed, nobody appeared in court to represent the interests of customers, or to oppose the claims of creditors whose interests were directly adverse to customers. Within days of the bankruptcy, the trustee did work with the CME and the CFTC to move customer positions and some of the margin associated with these accounts to other FCMs (Collins, 2012).

The trustee responsible for liquidating MF Global Inc. had to go through "a steep learning curve regarding futures operations," reported Collins (2012). It turns out that protections under the Commodity Exchange Act conflict with the U.S. Bankruptcy Code, so in the past regulators had moved customer positions and margins from weak Futures Commissions Merchants to healthy FCMs before the weak FCM declared bankruptcy. This action did not happen in the case of the MF Global bankruptcy, which is a key reason for the chaos surrounding its bankruptcy.

In summary, the firm did not have enough capital for its various lines of business. As cited in Stewart (2012) during the summer of 2011, the Assistant Treasurer of MF Global Inc. in Chicago "became worried about the firm's growing liquidity needs and where the cash would come from." She wrote in an email in August 2011: "Why is it I need to spend hours every day shuffling cash and loans from entity to entity?", describing the process as a "shell game," reported Stewart (2012). Figure 17 on the next page illustrates how money was continuously loaned from entity-to-entity during the firm's final month, frequently to ensure that each entity's capital requirements were met on a daily basis.

On June 27th, 2013, the CFTC charged that:
"MF Global [had] unlawfully used nearly one billion dollars of customer segregated funds to support its own proprietary operations and the operations of its affiliates .... [Former MF Global CEO Jon] Corzine bears responsibility for MF Global's unlawful acts. He held and exercised direct or indirect control over MF Global and Holdings and either did not act in good faith or knowingly induced these violations" (CFTC, 2013).

On January 4th, 2017, Corzine settled with the CFTC and paid $5 million to settle claims from the case. The regulator also set a lifetime ban on him personally trading other people's money in the futures industry.

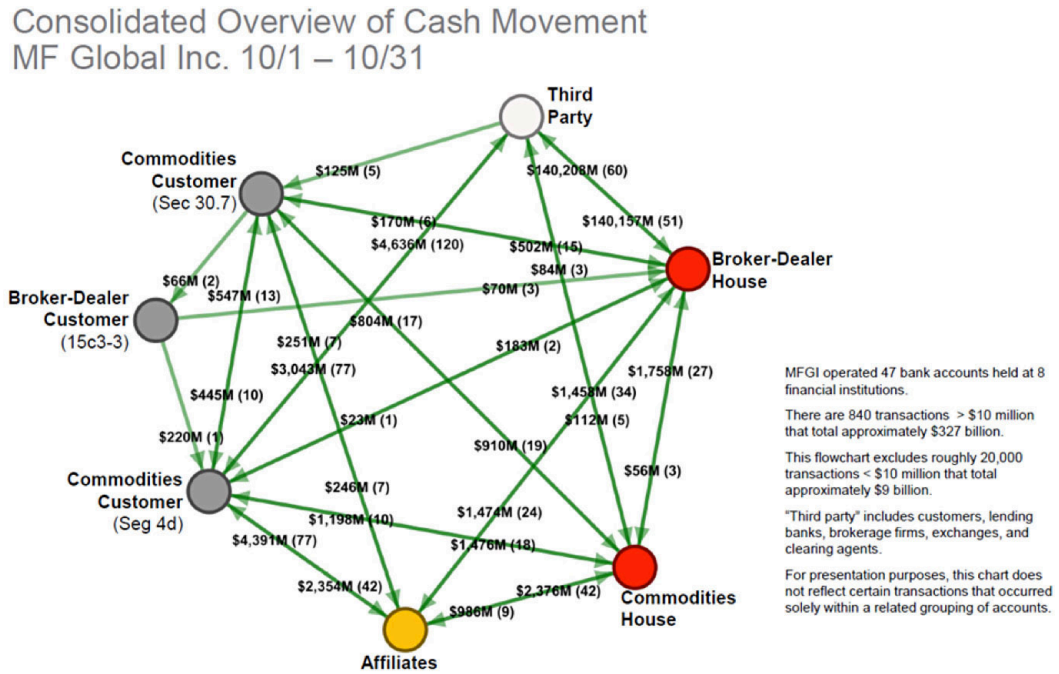
The lessons from the MF Global collapse are as follows:
- Futures customers can lose some or all of their collateral during the collapse of an FCM. All futures customers should do their own due diligence on the credit worthiness of their FCM; one can do so with the help of reports from the National Futures Association.
- A governmental or self-regulatory body should receive direct reports from custodian banks that hold futures customer margin, as is done in China. (The CME and NFA followed up with implementing a comparable system.)
- There should be a rigorous re-examination of the protections provided to futures customers, including improving and clarifying bankruptcy code priorities, and determining whether futures customers should be covered by insurance as in Canada.

Regarding reforms, the CFTC "approved new NFA rules that cover foreign accounts; controls on the use of excess segregated funds; and reporting and recordkeeping requirements," according to CFTC (2012). In addition, the NFA approved a requirement for "each futures commission merchant ... to provide its Designated Self-Regulatory Organization ... with view-only access via the Internet to account information for each of the FCM's customer segregated funds account(s) maintained and held at a bank or trust company," announced NFA (2012).

Conclusion

Gaining expertise in the commodity markets usually occurs through trial-and-error experiences. The main goal of this paper is to provide enough cautionary notes and lessons to help others in making wise choices in futures trading.

Figure 17



Source: Hughes Hubbard & Reed LLP, Attorneys for James W. Giddens, Trustee for the SIPA Liquidation of MF Global Inc. (2012a), p. 10.

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Founded in 1906, EDHEC is one of the foremost international business schools. Operating from campuses in Lille, Nice, Paris, London and Singapore, EDHEC is one of the top 15 European business schools. Accredited by the three main international academic organisations, EQUIS, AACSB, and Association of MBAs, EDHEC has for a number of years been pursuing a strategy of international excellence that led it to set up EDHEC-Risk Institute in 2001. This Institute boasts a team of permanent professors, engineers and support staff, and counts a large number of affiliate professors and research associates from the financial industry among its ranks.

The Need for Investment Solutions and Risk Management

Investment management is justified as an industry only to the extent that it can demonstrate a capacity to add value through the design of dedicated and meaningful investor-centric investment solutions, as opposed to one-size-fits-all manager-centric investment products. After several decades of relative inertia, the much needed move towards investment solutions has been greatly facilitated by a true industrial revolution triggered by profound paradigm changes in terms of (1) mass production of cost- and risk-efficient smart factor indices; (2) mass customisation of liability-driven investing and goal-based investing strategies; and (3) mass distribution, with robo-advisor technologies. In parallel, the investment industry is strongly impacted by two other major external revolutions, namely the digital revolution and the environmental revolution.

In this fast-moving environment, EDHEC-Risk Institute positions itself as the leading academic think-tank in the area of investment solutions, which gives true significance to the investment management practice. Through our multi-faceted programme of research, outreach, education and industry partnership initiatives, our ambition is to support industry players, both asset owners and asset managers, in their efforts to transition towards a novel, welfare-improving, investment management paradigm.

EDHEC-Risk New Initiatives

In addition to the EDHEC Alternative Indexes, which are used as performance benchmarks for risk analysis by investors in hedge funds, and the EDHEC-IEIF Monthly Commercial Property index, which tracks the performance of the French commercial property market through SCPIs, EDHEC-Risk has recently launched a series of new initiatives.

- The EDHEC-Princeton Retirement Goal-Based Investing Index Series, launched in May 2018, which represent asset allocation benchmarks for innovative mass-customised target-date solutions for individuals preparing for retirement;

- The EDHEC Bond Risk Premium Monitor, the purpose of which is to offer to investment and academic communities a tool to quantify and analyse the risk premium associated with Government bonds;

- The EDHEC-Risk Investment Solutions (Serious) Game, which is meant to facilitate engagement with graduate students or investment professionals enrolled on one of EDHEC-Risk's various campus-based, blended or fully-digital educational programmes.

About EDHEC-Risk Institute

Academic Excellence and Industry Relevance

In an attempt to ensure that the research it carries out is truly applicable, EDHEC has implemented a dual validation system for the work of EDHEC-Risk. All research work must be part of a research programme, the relevance and goals of which have been validated from both an academic and a business viewpoint by the Institute's advisory board. This board is made up of internationally recognised researchers, the Institute's business partners, and representatives of major international institutional investors. Management of the research programmes respects a rigorous validation process, which guarantees the scientific quality and the operational usefulness of the programmes.

Seven research programmes have been conducted by the centre to date:
- Investment Solutions in Institutional and Individual Money Management;
- Equity Risk Premia in Investment Solutions;
- Fixed-Income Risk Premia in Investment Solutions;
- Alternative Risk Premia in Investment Solutions;
- Multi-Asset Multi-Factor Investment Solutions;
- Reporting and Regulation for Investment Solutions;
- Technology, Big Data and Artificial Intelligence for Investment Solutions.

EDHEC-Risk Institute's seven research programmes explore interrelated aspects of investment solutions to advance the frontiers of knowledge and foster industry innovation. They receive the support of a large number of financial companies. The results of the research programmes are disseminated through the EDHEC-Risk locations in the City of London (United Kingdom) and Nice, (France).

EDHEC-Risk has developed a close partnership with a small number of sponsors within the framework of research chairs or major research projects:
- **Financial Risk Management as a Source of Performance**,
in partnership with the *French Asset Management Association (Association Française de la Gestion financière – AFG)*;
- **ETF, Indexing and Smart Beta Investment Strategies**,
in partnership with *Amundi*;
- **Regulation and Institutional Investment**,
in partnership with *AXA Investment Managers*;
- **Optimising Bond Portfolios**,
in partnership with *BDF Gestion*;
- **Asset-Liability Management and Institutional Investment Management**,
in partnership with *BNP Paribas Investment Partners*;
- **New Frontiers in Risk Assessment and Performance Reporting**,
in partnership with *CACEIS*;
- **Exploring the Commodity Futures Risk Premium: Implications for Asset Allocation and Regulation**,
in partnership with *CME Group*;
- **Asset-Liability Management Techniques for Sovereign Wealth Fund Management**,
in partnership with *Deutsche Bank*;

About EDHEC-Risk Institute

• **The Benefits of Volatility Derivatives in Equity Portfolio Management,**
in partnership with *Eurex*;
• **Innovations and Regulations in Investment Banking,**
in partnership with the *French Banking Federation (FBF)*;
• **Dynamic Allocation Models and New Forms of Target-Date Funds for Private and Institutional Clients,**
in partnership with *La Française AM*;
• **Risk Allocation Solutions,**
in partnership with *Lyxor Asset Management*;
• **Infrastructure Equity Investment Management and Benchmarking,**
in partnership with *Meridiam and Campbell Lutyens*;
• **Risk Allocation Framework for Goal-Driven Investing Strategies,**
in partnership with *Merrill Lynch Wealth Management*;
• **Financial Engineering and Global Alternative Portfolios for Institutional Investors,**
in partnership with *Morgan Stanley Investment Management*;
• **Investment and Governance Characteristics of Infrastructure Debt Investments,**
in partnership with *Natixis*;
• **Advanced Investment Solutions for Liability Hedging for Inflation Risk,**
in partnership with *Ontario Teachers'* Pension Plan;
• **Cross-Sectional and Time-Series Estimates of Risk Premia in Bond Markets,**
in partnership with *PIMCO*;
• **Active Allocation to Smart Factor Indices,**
in partnership with *Rothschild & Cie*;
• **Solvency II,**
in partnership with *Russell Investments*;
• **Advanced Modelling for Alternative Investments,**
in partnership with *Société Générale Prime Services (Newedge)*;
• **Structured Equity Investment Strategies for Long-Term Asian Investors,**
in partnership with *Société Générale Corporate & Investment Banking*.

The philosophy of the Institute is to validate its work by publication in international academic journals, as well as to make it available to the sector through its position papers, published studies and global conferences.

To ensure the distribution of its research to the industry, EDHEC-Risk also provides professionals with access to its website, https://risk.edhec.edu, which is devoted to international risk and investment management research for the industry. The website is aimed at professionals who wish to benefit from EDHEC-Risk's analysis and expertise in the area of investment solutions. Its quarterly newsletter is distributed to more than 150,000 readers.

About EDHEC-Risk Institute

Research for Business

EDHEC-Risk Institute also has highly significant executive education activities for professionals, in partnership with prestigious academic partners. EDHEC-Risk's executive education programmes help investment professionals upgrade their skills with advanced asset allocation and risk management training across traditional and alternative classes.

In 2012, EDHEC-Risk Institute signed two strategic partnership agreements. The first was with the Operations Research and Financial Engineering department of Princeton University to set up a joint research programme in the area of investment solutions for institutions and individuals. The second was with Yale School of Management to set up joint certified executive training courses in North America and Europe in the area of risk and investment management.

As part of its policy of transferring know-how to the industry, in 2013 EDHEC-Risk Institute also set up ERI Scientific Beta, which is an original initiative that aims to favour the adoption of the latest advances in smart beta design and implementation by the whole investment industry. Its academic origin provides the foundation for its strategy: offer, in the best economic conditions possible, the smart beta solutions that are most proven scientifically with full transparency in both the methods and the associated risks.

EDHEC-Risk Institute also contributed to the 2016 launch of EDHEC Infrastructure Institute (EDHEC*infra*), a spin-off dedicated to benchmarking private infrastructure investments. EDHEC*infra* was created to address the profound knowledge gap faced by infrastructure investors by collecting and standardising private investment and cash flow data and running state-of-the-art asset pricing and risk models to create the performance benchmarks that are needed for asset allocation, prudential regulation and the design of infrastructure investment solutions.

EDHEC-Risk Institute Publications and Position Papers (2016-2019)

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Publications and Position Papers (2016-2019)

2019

- Le Sourd, V. and L. Martellini. The EDHEC European ETF and Smart Beta and Factor Investing Survey 2019 (August).
- Maeso, J.M., Martellini, L. and R. Rebonato. Cross-Sectional and Time-Series Momentum in US Sovereign Bond Market (May).
- Maeso, J.M., Martellini, L. and R. Rebonato. Defining and Expoiting Value in Bonds (May).
- Maeso, J.M., Martellini, L. and R. Rebonato. Factor Investing in Sovereign Bond Markets - Time-Series Perspective (May).

2018

- Goltz, F. and V. Le Sourd. The EDHEC European ETF and Smart Beta and Factor Investing Survey 2018 (August).
- Mantilla-Garcia, D. Maximising the Volatility Return: A Risk-Based Strategy for Homogeneous Groups of Assets (June).
- Giron, K., L. Martellini, V. Milhau, J. Mulvey and A. Suri. Applying Goal-Based Investing Principles to the Retirement Problem (May).
- Martellini, L. and V. Milhau. Smart Beta and Beyond: Maximising the Benefits of Factor Investing (February).

2017

- Amenc, N., F. Goltz, V. Le Sourd. EDHEC Survey on Equity Factor Investing (November).
- Amenc, N., F. Goltz, V. Le Sourd. The EDHEC European ETF and Smart Beta Survey 2016 (May).
- Maeso, J.M., Martellini, L. Maximising an Equity Portfolio Excess Growth Rate: A New Form of Smart Beta Strategy? (November).
- Martellini, L. and V. Milhau. Mass Customisation versus Mass Production in Retirement Investment Management. Addressing a "Tough Engineering Problem" (May).
- Esakia, M., F. Goltz, S. Sivasubramanian and J. Ulahel. Smart Beta Replication Costs (February).
- Maeso, J.M., Martellini, L. Measuring Volatility Pumping Benefits in Equity Markets (February).

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- Amenc, N., F. Goltz, V. Le Sourd. Investor Perceptions about Smart Beta ETFs (August).
- Giron, K., L. Martellini and V. Milhau Multi-Dimensional Risk and Performance Analysis for Equity Portfolios (July).
- Maeso, J.M., L. Martellini. Factor Investing and Risk Allocation. From Traditional to Alternative Risk Premia Harvesting (June).
- Amenc, N., F. Goltz, V. Le Sourd, A. Lodh and S. Sivasubramanian. The EDHEC European ETF Survey 2015 (February).
- Martellini, L. Mass Customisation versus Mass Production in Investment Management (January).

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