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Nearly 10 years after its nadir, quantitative investing is again the hot trend in finance. *By Robin Wigglesworth*

Goldman Sachs' lessons from the 'quant quake'

Speed read

Heavy losses Groups such as Goldman Sachs' quantitative division suffered a rout in the August 2007 'quant quake'

Crowding fears The post-crisis growth of quantitative investment has stirred fears over another market storm

Busy signals The industry has grown in complexity, but now analyses many more factors to generate returns

It was a typical New York summer day, the kind where arriving at Goldman Sachs' perfectly air-conditioned offices in downtown Manhattan was a blissful release from the humid weather outside. But for Gary Chropuvka it proved to be one of the worst days ofhis life.

Mr Chropuvka worked at Goldman's money management arm, specifically at Quantitative Investment Strategies, a division staffed by mathematicians, computer scientists and physicists. Even at Goldman, the QIS employees were considered intellectual superstars. Their prowess at decoding the signals of financial markets meant the unit managed $165bn at its peak — more than any hedge fund group.

But on August 6 2007, everything unravelled. As soon as US markets started trading, the previously wildly successful automated investment algorithms coded by the QIS brainiacs went horribly awry, and losses mounted at a frightening pace.

What became known as the "quant quake" subsided in a week and was largely contained within the computer-powered investment industry. It was soon overshadowed by the global financial crisis. But it scarred a generation of financial scientists on Wall Street. Even Renaissance Technologies, the legendary hedge fund co-founded by cold war codebreaker James Simons, suffered painful losses, and it nearly obliterated Goldman's QIS.

"All this worked academically, and for a long time it worked in practice, and then all of a sudden you have this horrible event," Mr Chropuvka says. "It was the most humbling experience of our lives."

'The core idea that computers can do a lot of this better than humans was right. We're just at the early stages of this revolution'

Crisis point: traders on the New York Stock Exchange face up to their losses in August 2007. The 'quant quake' that month was overshadowed by the global financial crisis
Mario Tama/Getty Images

Nearly a decade later, quantitative investing is once again the hottest trend in finance. Computer-driven hedge funds have just notched up their eighth straight year of client inflows, doubling their assets from 2009 to $918bn, according to Hedge Fund Research. Even this understates the interest, as many traditional hedge funds and big mutual fund managers are all trying to blend more quantitative techniques with their traditional approaches.

QIS is emblematic of the quant renaissance. In 2011 Goldman Sachs put its top computer wizard, Armen Avanessians, in charge of the division. He has helped turn round its fortunes. The arm's assets under management reached a nadir of $38bn in 2012, but it now manages $91.8bn — still below the unit's pre-crisis peak.

"The first thing I did was to fly to our biggest clients and apologise," he says. "All bad things involve crowding and leverage, and the quant crisis was no different. But the core idea that computers can do a lot of this better than humans was right . . . I feel that we're just at the early stages of this quant revolution, and that gets me excited."

The explosive growth of algorithmic investing — whether high-frequency traders, next-generation exchange traded funds or artificial intelligence-powered hedge funds — has transformed the markets. Some analysts fear that another 2007-style meltdown would be more severe due to the proliferation of quant strategies.

"It's the biggest worry I have," says Richard Bookstaber, a former risk manager at Morgan Stanley and Moore Capital, now a research principal at the US Treasury's Office of Financial Research. "What is going on now is not just the growth of quant hedge funds, like before the crisis. Now it's system-wide across the investment world. In 2007 it was localised because no one else was pursuing these strategies. Now everyone is."

Persistent signals

Roughly a dozen analysts and fund managers shuffle into an airy corner office at Goldman's New York headquarters to hear the co-heads of research at QIS's Equity Alpha Strategies team, Dennis Walsh and Takashi Suwabe, present some of their data crunching.

Mr Walsh outlines how they can profit from even the most common of corporate events: quarterly earnings calls. Using an AI technique called "natural language processing", Goldman's algorithms can systematically look for verbal cues from analysts on the call that might indicate whether they were pleasantly or unpleasantly surprised at the results — and therefore upgrade their outlook in response.

"There's a tendency towards praise to keep in management's good books, but only marginally. If 20 out of 30 analysts say 'great quarter' then it probably was," Mr Walsh says. It may seem sketchy, but success for quants depends on detecting small but persistent signals that they can feed into trading algorithms.

QIS has been radically restructured since its near-death experience in 2007, and focuses on three main areas. Its biggest part is the $35bn "tax-efficient strategies" unit which structures investment products for wealthy Goldman clients. But QIS executives say the main priorities are its $31bn "smart beta" ETF business, which invests in specific market factors or characteristics, the $16bn Equity Alpha arm and a small but promising $3.2bn "alternative risk premia" business, where financial engineers try to deconstruct and cheaply replicate hedge fund returns.

The future of the business will be powered by data. "The amount of data out there is awesome," says Mr Chropuvka, one of two Goldman partners at QIS. "Figuring out the linkages between companies has become more complicated, and quants like using computers to help figure these things out. We have for decades played the breadth game, but with big data we can play the depth game. We can do it more comprehensively, and in real time."

Another signal explored by Goldman's quantitative analysts is something they term "geographic momentum", based on how companies in one corner of the planet can often offer clues to how others in the same region are performing.

QIS has crunched the data ofits 14,800 stocks across 1m locations, using "machine learning" to find and quantify hidden relationships and linkages that might often cross state, regional or even country borders, and sliced the world into 200 distinct "economic clusters" where companies tend to move in tandem. A French bank with a big loan book in eastern Europe might offer clues to how Polish contractors are doing, or Texan developers might indicate the health of Mexican cement sales.

$918bn
Assets under management by computer-driven hedge funds in 2016, its eighth straight increase in inflows

$91.8bn
Assets under management by Goldman's QIS unit, up from $38bn in 2012 but still below its peak of $165bn

Leveraged complexity

The investment industry's enthusiasm for the potential ofbig data, superfast computers and AI is palpable — and not just among quant hedge funds. State Street, a $2.4tn asset manager, believes this is the "next evolutionary step" for the sector. BlackRock, the world's biggest fund manager, has said it "represents a watershed moment in the history ofinvestment management".

The enthusiasm mostly reflects a view of where markets and investing are heading. Aside from a few elite firms, even the industry's more sophisticated players can struggle for consistent returns. HFR's quant hedge fund index has been far less volatile than the broader industry universe, but gained only 1.7 per cent last year.

Yin Luo, head of quantitative research at Wolfe Research, says the pre-crisis era was the "golden age" for the industry, when "almost everything worked, even ifit wasn't fancy". Now, it is much harder, with many common signals and strategies copied into oblivion.

Nor is hiring a lot of smart data scientists a silver bullet. BlackRock has poured money into its Scientific Active Equity division, but almost two-thirds ofits quant funds underperformed their benchmarks last year, according to a presentation acquired by Bloomberg. Jeff Shen, the unit's co-head, attributes the poor performance to the turbulent start to 2016. But it still highlights that quantitative investing can be tricky.

The head of one big quant hedge fund compares the phenomenon to Kodak, the camera company that saw the rise of digital photography coming but was still unable to refocus the business, and eventually went bankrupt. "Even if you recognise something is changing, it's not easy to revamp the business," he says.

Nonetheless, the quant revolution is transforming investment. The convoluted but broadly explicable financial markets of previous generations have evolved into an electronic jungle of unfathomable complexity.

Understanding how markets function increasingly requires knowledge of a Greek-based alphabet soup of concepts and phenomena — such as alpha generation, smart beta, gamma scalping, delta hedging and option theta. Their speed has accelerated markedly, and the number of market anomalies, odd trading patterns and mysterious "flash crashes" have increased in tandem with the ascent of algorithms.

Yet one of the biggest fears is that the money pouring into quantitative investing could be laying the seeds of a bigger re-run of the 2007 quant quake.

The precise trigger for the quake might never be known, but analysts generally agree the pot was brought to a boil by too many big investors unknowingly making the same trades while juicing up their returns with leverage. When the financial crisis began, one of the bigger players was likely to have been hit by subprime mortgage losses, forcing it to sell its more liquid but highly leveraged equity portfolio to satisfy investor withdrawals. Losses hammered participants with similar trades and triggered fresh rounds ofliquidation.

Goldman's QIS division is sometimes fingered as one of the potential culprits in triggering the quant quake — specifically its once-imperious Global Alpha fund that was closed in 2011 — something its executives vehemently deny. QIS was simply one of the biggest victims because several ofits funds had used "an unbelievable amount ofleverage", Mr Chropuvka says.

'We focus on what can go wrong'

The kind ofleverage used in 2007 has largely been banished from the financial system. President Donald Trump's planned regulatory rollback might shake things up, but much of the reduction is attributed to heightened caution after the crisis. Moreover, while billions of dollars have been poured into quantitative strategies in recent years, their variety has increased significantly.

Indeed, the rise ofbig data could lead to a new golden era for the industry, Mr Shen says. "The world is more complex and diverse now. That makes it harder [to perform], but it makes crowding less of a risk."

'We have for decades played the breadth game but with big data we can play the depth game. And we can do it in real time'

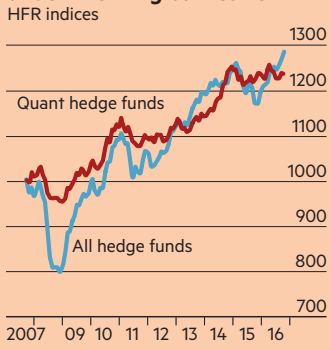
QIS is a case in point. While its quants might have tapped into only a dozen or so signals in 2007, they now use more than 250 with much less leverage. That means the dangers of crowded strategies that proved so toxic nearly a decade ago should be reduced.

While Mr Avanessians is "always paranoid that I'm missing something", he says Goldman's quants have learnt the lessons of 2007. "We now have a maniacal focus on what can go wrong, rather than what can go right."

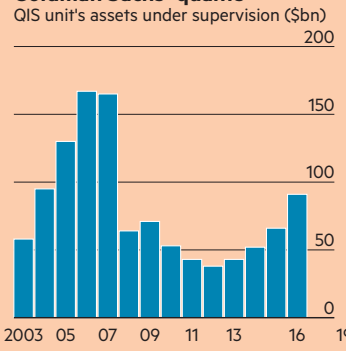
Not everyone is convinced. Mr Bookstaber points out that while leverage is more limited, the swelling "smart beta" industry is a way that another quant quake could hit the masses. With quants becoming more dominant, fears of another electronically generated market meltdown will persist.

"We're caught in a tug of war between Moore's Law and Murphy's Law," says Andrew Lo, finance professor at the Massachusetts Institute of Technology, referring to Gordon Moore's prediction that computing power would double nearly every year, and the adage that anything that can go wrong, will go wrong. "Our technology has outgrown our ability to manage it, and the financial world is increasing in complexity and fragility."

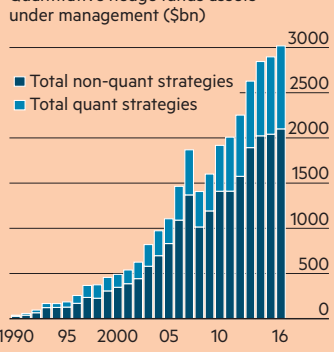
Quant hedge fund returns underwhelming but resilient
HFR indices



The unlikely renaissance of Goldman Sachs' quants
QIS unit's assets under supervision ($bn)



Quant funds seize the assets
Quantitative hedge funds assets under management ($bn)



Sources: Hedge Fund Research; Goldman Sachs

Alt-risks

Quants bid to beat hedge funds at their own game

One of the smallest but potentially most intriguing units at Goldman Sachs' Quantitative Investment Services is arguably its "alternative risk premia" unit, where a bunch of financial scientists attempt to reverse-engineer and then replicate the secret sauce of hedge funds.

Over the years, quantitative analysts have discovered that a lot of the market-beating "alpha" returns produced by supposedly skilled fund managers can often be attributed to specific factors and market characteristics, such as momentum or cheap valuations. These factors are now often packaged into exchange traded funds as "smart beta".

But recently, quants say they have even been able to deconstruct and rebuild many of the "risk premia" components of sophisticated hedge fund strategies — such as arbitraging mergers and acquisitions, or placing bets on global bond and currency movements — and sell them at a fraction of the cost.

In April 2012 Goldman Sachs transferred about 20 of its financial engineers from the investment bank's securities side to QIS, where they set up an alternative risk premia division to decipher and duplicate an array of hedge fund products for institutional clients.

So far it has only been a modest success. At the end of last year, the unit's assets under management stood at $3.2bn. But Goldman executives have pinpointed it as one of its three main priorities, convinced that it can become a money-spinning factory for mass production of cheap hedge fund returns for its clients.

Nonetheless, some quants — let alone many hedge fund managers — are sceptical, arguing that a lot of the supposed success of hedge fund replication is based mostly on "backtests", running the models against historical data. And a lot of strategies that work when tested on backward-looking data can fizzle out when confronted with moving markets.

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