



## Quant Investing: Past, Present, Future

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# What is Quant Investing?

Quantitative or scientific investing applies rigorous and systematic analysis—the scientific method—to investing. Scientific investors use the scientific method to develop return forecasts, and then construct portfolios by optimally trading off those expected returns against risk and trading costs.

Many implementations of quantitative investing have focused on return forecasts proportional to a few well-known, publicly available financial ratios, including book-to-price, earnings-to-price, price momentum, and analyst estimate revisions. We must distinguish what many practitioners have done, with the larger bailiwick of quantitative investing.

Quantitative investing differs from Fundamental investing in some important ways, but in other ways are closer than many investors believe:

	Quantitative Investing	Fundamental Investing
Investment Ideas	Limited only by imagination and data.	Limited only by imagination
Data gathering	Very large amount of numerical and text data.	Numerical and text data, company visits
Portfolios	Large number of assets, process-driven	Fairly concentrated portfolios
Management	Team-based	Manager-based

# Fundamental Law of Active Management

Quant investors are very focused on delivering *consistent* positive performance, i.e. high Information Ratios.

- Focus on risk-adjusted returns, not just returns.

Quant investors are particularly influenced by the Fundamental Law of Active Management:

$$IR = IC \cdot \sqrt{BR} \cdot TC$$

- Delivering high Information Ratios requires a winning combination of skill, breadth, and efficiency.
  - Quant investors focus on all three components.
  - Fundamental investors mainly focus on skill.
- This helps explain the difference in numbers of assets in portfolios, and the quant interest in market neutral and 130/30 strategies.

# The Quant Research Process (BlackRock version)

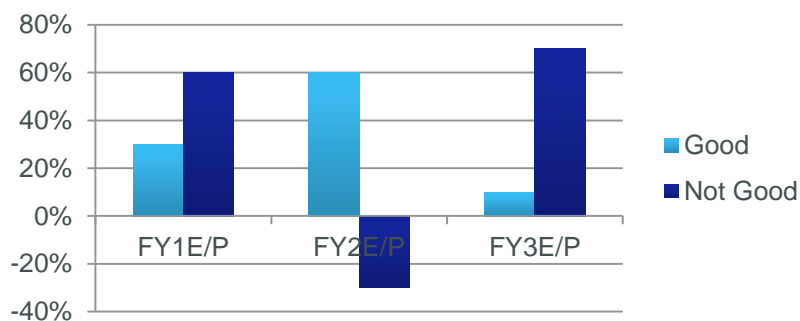
## Scientific Method

- Hypothesis
- Empirical Testing

## Avoiding Datamining

- Not randomly searching for patterns in historical data.
- Avoid overfitting to data:

### Example: Weighting Value Signals



## Maximizing the Probability of Future Success

- Sensibility
- Ancillary Testing
- Section 7
- Referee

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Essay

## Why Most Published Research Findings Are False

John P.A. Ioannidis

### Summary

There is increasing concern that most current published research findings are false. The probability that a research claim is true may depend on study power and bias, the number of other studies on the same question, and, importantly, the ratio of true to no relationships among the relationships posited in each scientific field. In this framework, a research finding is less likely to be true when the studies conducted in a field are smaller, when effect sizes are smaller, when there is a greater number and lower precision of tested relationships, when there is greater flexibility in designs, definitions, outcomes, and analytical modes; when there is greater financial and other interest and prejudice; and when more teams are involved in a scientific field in chase of statistical significance. Simulations show that for most study designs and settings, it is more likely for a research claim to be false than true. Moreover, for many current scientific fields, current research findings may often be simply accurate measures of the prevailing bias. In this essay, I discuss the implications of these problems for the conduct and interpretation of research.

Published research findings are sometimes refined by subsequent evidence, with ensuing confirmation and disappointment. Refutation and controversy is seen across the range of research designs, from clinical trials and traditional epidemiological studies [1-3] to the most modern molecular research [4,5]. There is increasing concern that in modern research, false findings may be the majority or even the vast majority of published research claims [6-8]. However, this should not be surprising. It can be proven that most claimed research findings are false. Here I will examine the key

The essay section contains opinion pieces on topics of broad interest to a general medical audience.

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factors that influence this problem and some corollaries thereof.

### Modeling the Framework for False Positive Findings

Several methodologists have pointed out [9-11] that the high rate of nonreplication (lack of confirmation) of research discoveries is a consequence of the common, yet ill-considered strategy of claiming conclusive research findings solely on the basis of a single study assessed by formal statistical significance, typically for a *p* value less than 0.05. Research is not most appropriately represented and summarized by *p* values, but, unfortunately, there is a widespread notion that medical research articles

**It can be proven that most claimed research findings are false.**

should be interpreted based only on *p* values. Research findings are defined here as any relationship reaching formal statistical significance, e.g., effective interventions, informative predictors, risk factors, or associations. "Negative" research is also very useful. "Negative" is actually a misnomer, and the misinterpretation is widespread. However, here we will target relationships that investigators claim exist, rather than null findings.

As has been shown previously, the probability that a research finding is indeed true depends on the prior probability of it being true (before doing the study), the statistical power of the study, and the level of statistical significance [10,11]. Consider a  $2 \times 2$  table in which research findings are compared against the gold standard of true relationships in a scientific field. In a research field both true and false hypotheses can be made about the presence of relationships. Let *R* be the ratio of the number of "true relationships" to "no relationships" among those tested in the field. *R*

is characteristic of the field and can vary a lot depending on whether the field targets highly likely relationships or searches for only one or a few true relationships among thousands and millions of hypotheses that may be postulated. Let us also consider, for computational simplicity, circumscribed fields where either there is only one true relationship (among many that can be hypothesized) or the power is similar to find any of the several existing true relationships. The pre-study probability of a relationship being true is  $R/(R + 1)$ . The probability of a study finding a true relationship reflects the power  $1 - \beta$  (one minus the Type II error rate). The probability of claiming a relationship when none truly exists reflects the Type I error rate,  $\alpha$ . Assuming that relationships are being probed in the field, the expected values of the  $2 \times 2$  table are given in Table 1. After a research finding has been claimed based on achieving formal statistical significance, the post-study probability that it is true is the positive predictive value, PPV. The PPV is also the complementary probability of what Wacholder et al. have called the false positive report probability [10]. According to the  $2 \times 2$  table, one gets  $PPV = (1 - \beta)R / (R - \beta R + 0)$ . A research finding is thus

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Abbreviations: PPV, positive predictive value; John P.A. Ioannidis is in the Department of Hygiene and Epidemiology, University of Ioannina School of Medicine, Ioannina, Greece, and Institute for Clinical Research and Health Policy Studies, Department of Medicine, Tufts New England Medical Center, Tufts University School of Medicine, Boston, Massachusetts, United States of America. E-mail: ioannidis@cc.uoi.gr

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# Past, Present, Future

**How have quantitative strategies—and markets—evolved over time?**

**We will follow a few metrics, including:**

- Investment ideas and Influences
- Asset Levels
- Data
- Technology
- Portfolios
- Market Environments

**I will mainly discuss quantitative equity strategies, though quant strategies can and do cover all asset classes.**



# The Infancy of Quant Investing: 1960s – 1980s

## Investment Ideas and Influences:

- Academic Origins: Ben Graham, Markowitz, CAPM, Treynor-Black, Barr Rosenberg
- The Q-Group founded in 1967
- Index Funds
- Risk Premia: Size and Value, backtested over ~20 year history

## Asset Levels

- Slow growth up to ~\$3 - \$4 Billion

## Data

- CRSP, Compustat
- Long history of prices, volumes, fundamentals

## Technology

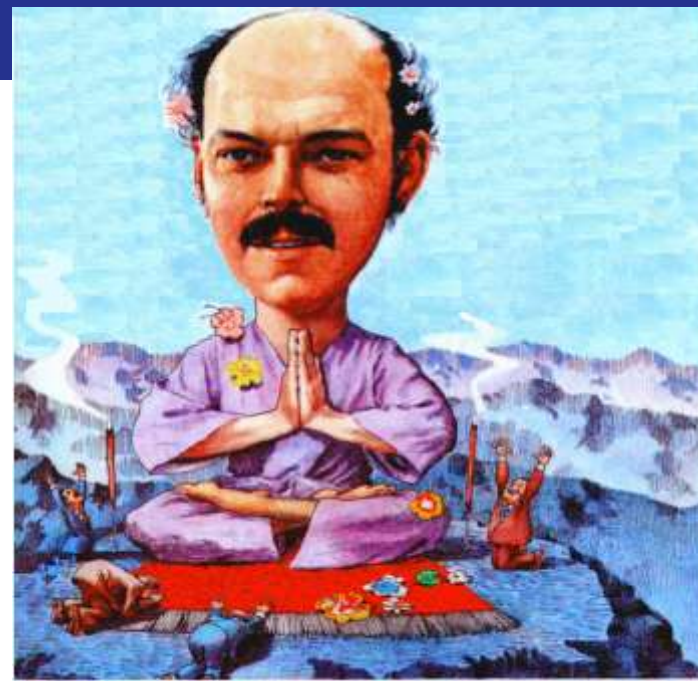
- Mainframe time-sharing, slowly evolving to PC-based (1982: 16-bit Intel 80286)
- Limited amounts of computation and storage (1987: 3 1/2 inch floppy, 2.88 MB capacity)
- Rapid progress in the field of numerical analysis provides accessible numerical libraries (EISPACK, LINPACK) and eventually personal numerical computing environments (1984: Matlab v1.0).

## Portfolios

- Long-only

## Market Environments

- Almost all investing is fundamental active.
- Long period that included Nifty Fifty phase, oil crisis and bear market of 70's to early 80's.
- Indexing began in the 1970's. Quant investing started around that time. Stat Arb (pairs trading) started by the mid-1980's.
- By the end of the 1980's, quant investing had expanded from the US to Japan, US Smallcap, UK, Europe, Canada, Australia



# The Teen Years: 1990s

## Investment Ideas and Influences

- Earnings Surprise, Estimate Revisions, Earnings Quality: Strong focus on fundamentals
- Academics focused on proving market efficiency

## Asset Levels

- Increasing growth up to ~ \$80 - \$100 Billion

## Data

- CRSP, Compustat, IBES, First Call
- Analyst data: US history back to the 1970's (though spotty back then); much less history outside US

## Technology

- Rise of the internet: more rapid dissemination of general scientific research

## Portfolios

- Quants discover market neutral

## Markets

- 1989-1991 recession was followed by a bull market punctuated by local crises: Asian tigers, Russian default, LTCM; and then followed by the internet bubble with value massively underperforming. Some value managers folded.
- Quants generally delivered consistent performance over this period, through anti-crowd bets.
- High frequency firms grew over this period, while specialists declined.

投資の科学、それは戦略をも超える。

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# Early Adulthood: 1998 - 2006

## Investment Ideas & Influences

- Behavioral finance slowly gains acceptance, allowing academics to research potential inefficiencies.
- SSRN provides quick access to an increasing flow of market inefficiency papers.
- Increasing competition for ideas; many new ideas arbitrated away quickly
- Still almost entirely focused on fundamentals

## Asset Levels

- Explosive Growth
- The Quant Bubble
- Quant Assets rise to ~ \$1.5 - 2 Trillion

## Data

- Quants dabble with text analysis and network analysis techniques
- Google demonstrates impact of paradigms for massively scalable storage (GFS) and compute (MapReduce) on quantitative research.
- Proprietary Data / Surveys

## Portfolios

- Increasing leverage

## Markets

- Great quiescence: market volatility significantly below historical averages.
- Value pays off. Quality does well in wake of accounting scandals. Anti-crowd bets generally succeed.





# Mid-Life Crisis: Bursting the Bubble: 2007 - 2009

## Asset Levels

- Asset levels / Exposures down ~75%

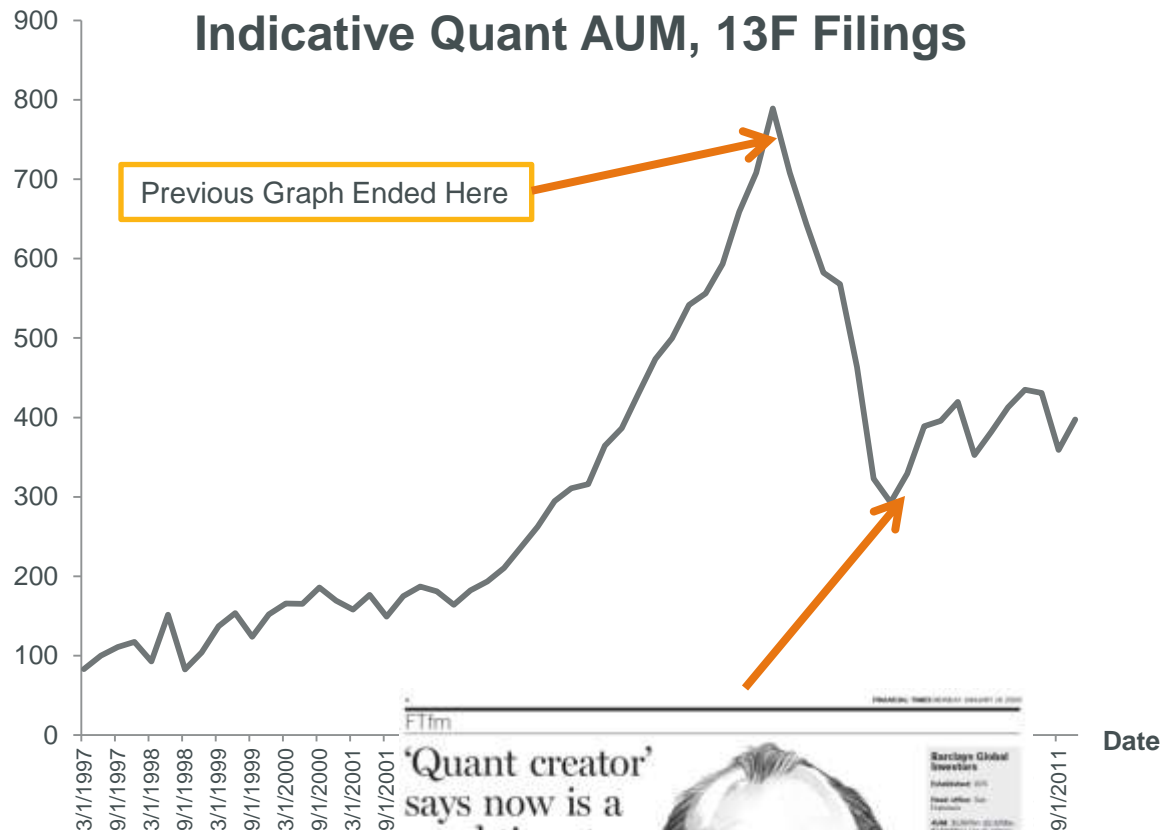
## Portfolios

- Shrinking / Deleveraging

## Market Environments

- Enormous outflows across correlated quant managers led to significant drag on all quant managers.
- The impact extended beyond just quant to many value managers (e.g Bill Miller)
- Dramatic increase in volatility, largely driven by macrofactors

## Indicative Quant AUM, 13F Filings



# Two Broad Views Came out of the Quant Crisis

## Stay the Course:

- Value has had many drawdowns over the past 100 years. It will come back.

## Need to Reinvent Quant:

- The Sharpe Ratio for value looking forward will be more in line with other known sources of risk, like market risk. It is an extremely well-known phenomenon.
- In any event, investors will not pay 2/20 for something increasingly available as an ETF.

**I am firmly in the second camp. This is the view that governs the efforts of the Scientific Active Equity team at BlackRock.**

## Other Lessons:

- Pay attention to competitors
- Long-term success will require finding diversifying, non-generic alpha.
- Illusion of Diversification: many different views of fundamentals

# The Present

## 2011 was a good year for Quant Investing generally.

- Most quant managers outperformed.
- Some claim that the “BGI Cubs” did particularly well

## Why?

- Generic quant ideas worked well
- New ideas worked well.
- Outflows have stopped

## Investment Ideas and Influences

- Value, Quality, Sentiment
- Dynamic exposure to traditional and alternative risk premia
- Initial ventures beyond stock selection
  - Trading baskets of stocks (themes)

## Asset Levels

- 25% of 2007 levels

## Data

- Numerical and text data. Some unstructured data and large datasets.
- Unique datasets with limited history

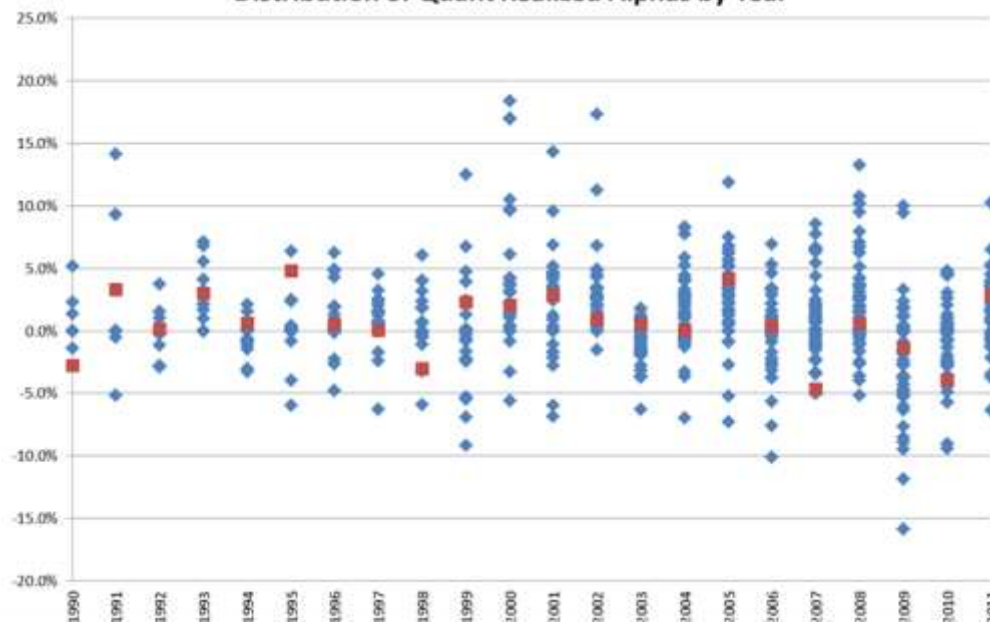
## Technology

- Big data techniques, cloud computing
- Ubiquitous super-computing—essentially unlimited amounts of storage and computing available on demand from the cloud.

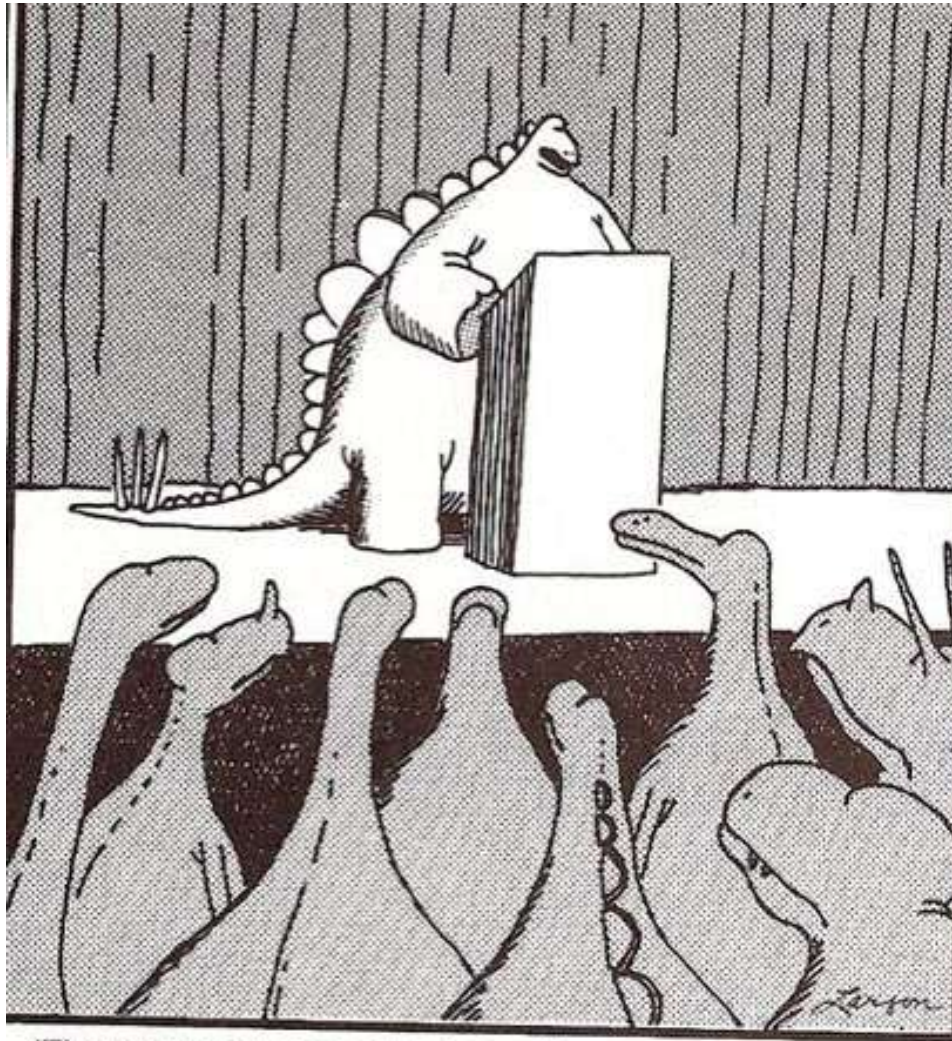
## Market Environments

- The world has changed: ETFs and High Frequency traders increasing parts of the market.

Distribution of Quant Realized Alphas by Year



# The Future of Quant Investing



**"The picture's pretty bleak, gentlemen. ... The world's climates are changing, the mammals are taking over, and we all have a brain about the size of a walnut."**

# The Future of Quant Investing

## Investment Ideas and Influences

- Dynamic exposure to traditional and alternative risk premia
- Beyond stock selection to include trading baskets of stocks (themes)
- Avoiding other quants
- Move beyond fundamentals

## Asset Levels

- Well short of 2007 levels

## Data

- Numerical and text data. Unstructured data. Large datasets.
- Unique datasets with limited history

## Technology

- Signals increasingly built through analysis of massive datasets.

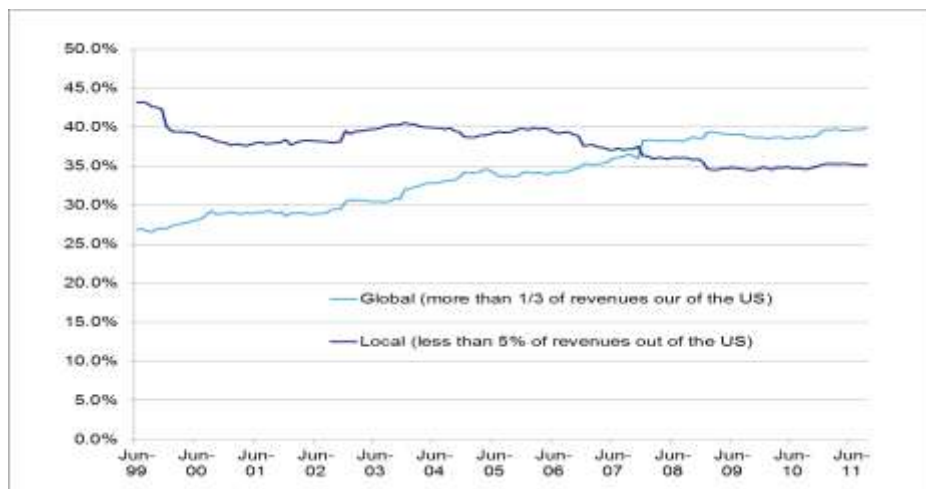
## Portfolios

- Less correlated with other quants.
  - The risk of crowding will continue to be an important issue for quants.
- More dynamic

# The Future of Quant Investing: Changing Market Environments

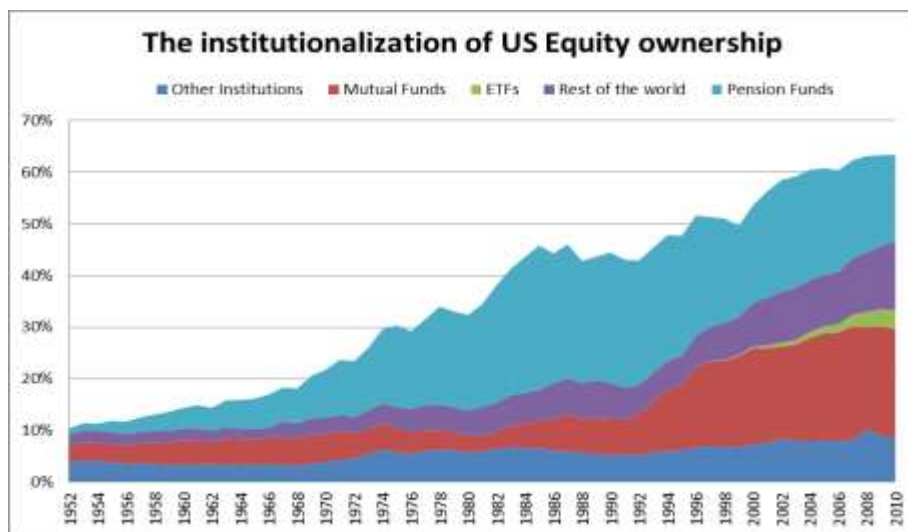
## Globalization

- Over the past decade, the % of “global” firms in the S&P 500 went from 25% to 40%.



## The Institutionalization of US Equity Ownership

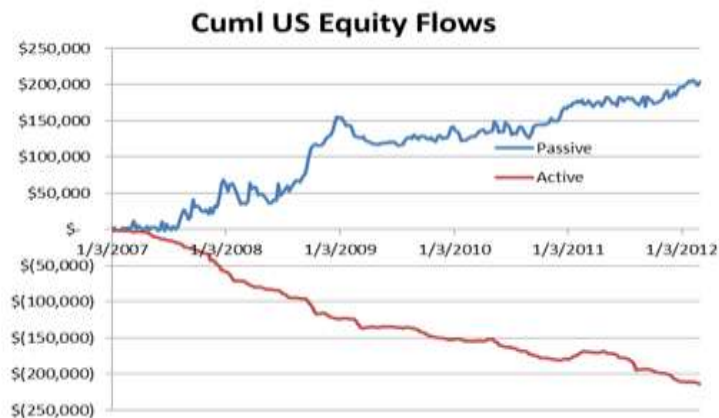
- The “other side of the trade” is very different from years ago.





# The Future of Quant Investing: Changing Market Environments

ETFs and Passive Funds generally are an increasing part of the market.



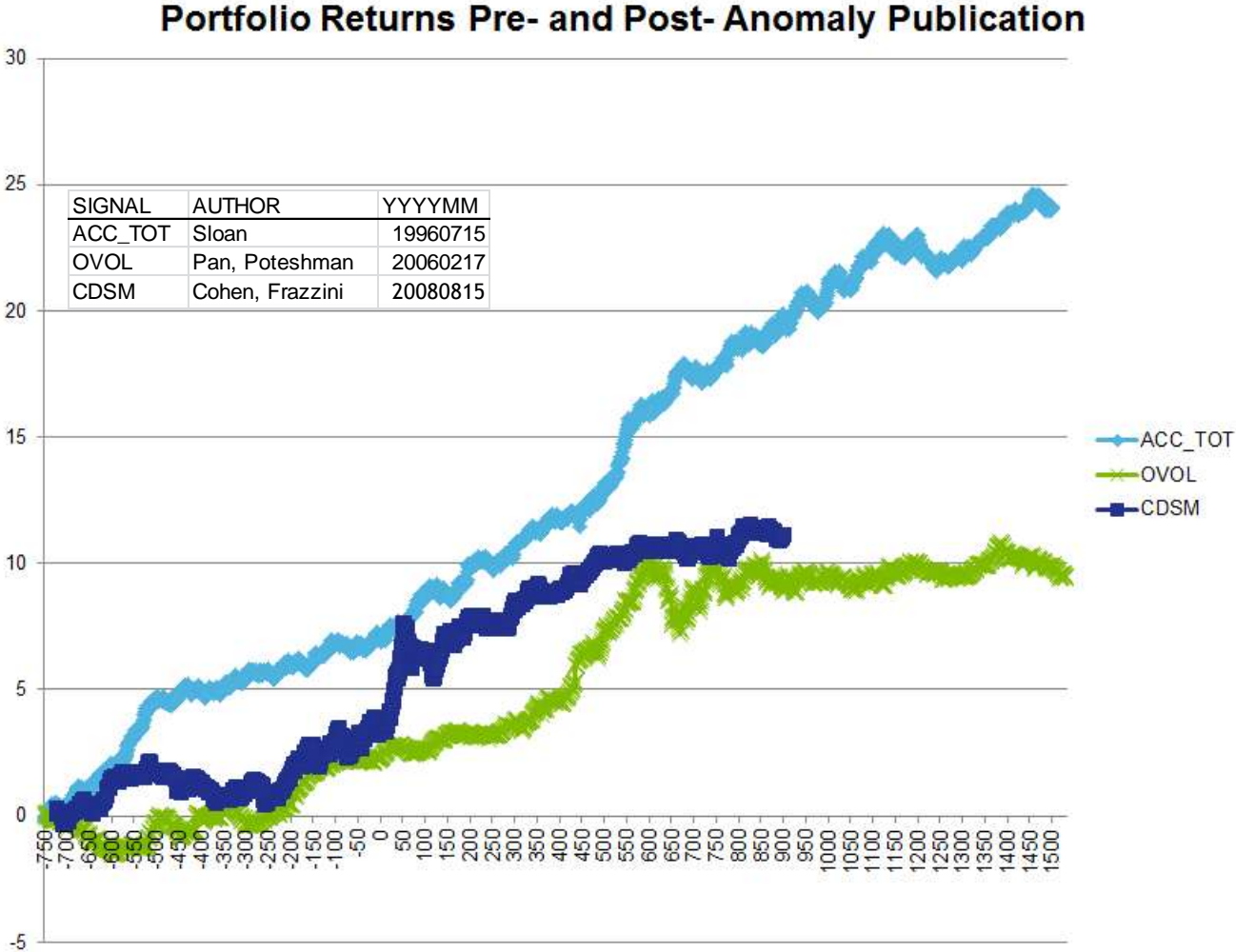
High Frequency traders have changed market microstructure.

- Over the past decade, block trades have dropped from 30% to 5% of NYSE volume; and average trade size has dropped from 1,000 to 200 shares.



# The Competitive Environment: Implementing Academic Research

The time between an idea's publication and its arbitraging away is shrinking:



# The Competitive Environment: Implementing Academic Research

Sell-Side Quant Equity Teams monitor, review, and rank academic insights on a regular basis:

## Welcome to our monthly Academic Insights report

### Fresh insights from academia

This month we continue to delve into two themes that have been generating a lot of interest not just in the academic world, but also among practitioners. The first is the information content of geographic segment data. Most international companies report sales by region, but the regional breakdown is often ad hoc and at the whim of the company. Nonetheless, recent academic research suggests that there is valuable information in such data, and indeed that it can be used to forecast future stock returns.

The second theme revolves around the growing interest in “true” risk premia, i.e. risks that we actually get compensated for taking. Higher risk – when measured by classic metrics like volatility or beta – tends to lead to lower future returns empirically. However, risk measures like the Variance Risk Premium (VRP) and Lower Tail Dependence (LTD) are the “right” way around in the sense that higher risk is compensated for through higher returns.

### Key papers this month

This month we focus on five papers spanning a range of topics including alpha generation, portfolio construction, and risk management:

- Extreme dependence structures and the cross-section of expected stock returns
- Firms’ degree of internationalization and the cross-section of stock returns: Evidence from multinational listed companies in the U.K.
- Macro to Micro: Country exposures, firm fundamentals and stock returns
- The variance risk premium around the world
- A proof of the optimality of volatility weighting over time

### Upcoming events

We also highlight upcoming conferences and seminars in the quantitative investing space that may be of interest.

### The best of the rest

At the back of this report we include abstracts from some additional papers that we think are also quite interesting. These are arranged by topic to make skimming the list quicker. If you need any further information on any of the papers in this

# The Competitive Environment: Implementing Academic Research

**QSG: Commercially-available Signal Library**

As of early 2008, this library included more than 600 factors linked to 2500 academic papers.

# The Competitive Environment: Technology

**Example: “Battle of the Quants” New York Conference, March 27-28, 2012**

## **Selections from the Agenda:**

- The Battle: Humanizing the Machine or Automating the Man
- Texts, Tweets, Twits – How is Market Sentiment Analysis of Value in Quantitative Trading?
- Artificial Intelligence and Machine Learning: The Time Has Come!
- Harnessing the Wisdom and Madness of Crowds to Generate Alpha
- Sourcing Data for Sentiment Analysis Models: News vs. Social Networking
- Analyzing, Tagging, Enabling, and Coding Sentiment Data for use in Financial Models?

**According to data from the Aite Group, 35% of quantitative firms are now using some kind of machine-readable newsfeed, up from 2% three years ago.**


# The Competitive Environment: Quest for Speed

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## The \$300m cable that will save traders milliseconds

In the high-speed world of automated financial trading, milliseconds matter. So much so, in fact, that a saving of just six milliseconds in transmission time is all that is required to justify the laying of the first transatlantic communications cable for 10 years at a cost of more than \$300m.




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# The Future of Quant Investing

## Is success possible?

- **Absolutely.**
- Good arguments that successful active management is possible.
  - Shiller's Excess Volatility
  - Behavioral Finance—systematic irrationality
- The opportunity set is large:
  - Specific volatility levels haven't changed much over time.
  - Factor volatility has increased greatly over the past few years, and should stay high for at least the next few years.
- Applying science to investing is the best way to achieve success.

## Will it be easy?

- **No.**
- But why would you expect success in a highly competitive, rapidly changing world to be easy?

## Will the journey offer opportunities for growth, for interacting with impressive colleagues, for fame and fortune?

- **It always has.**

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