A BRIEF HISTORY OF SYSTEMATIC INVESTING

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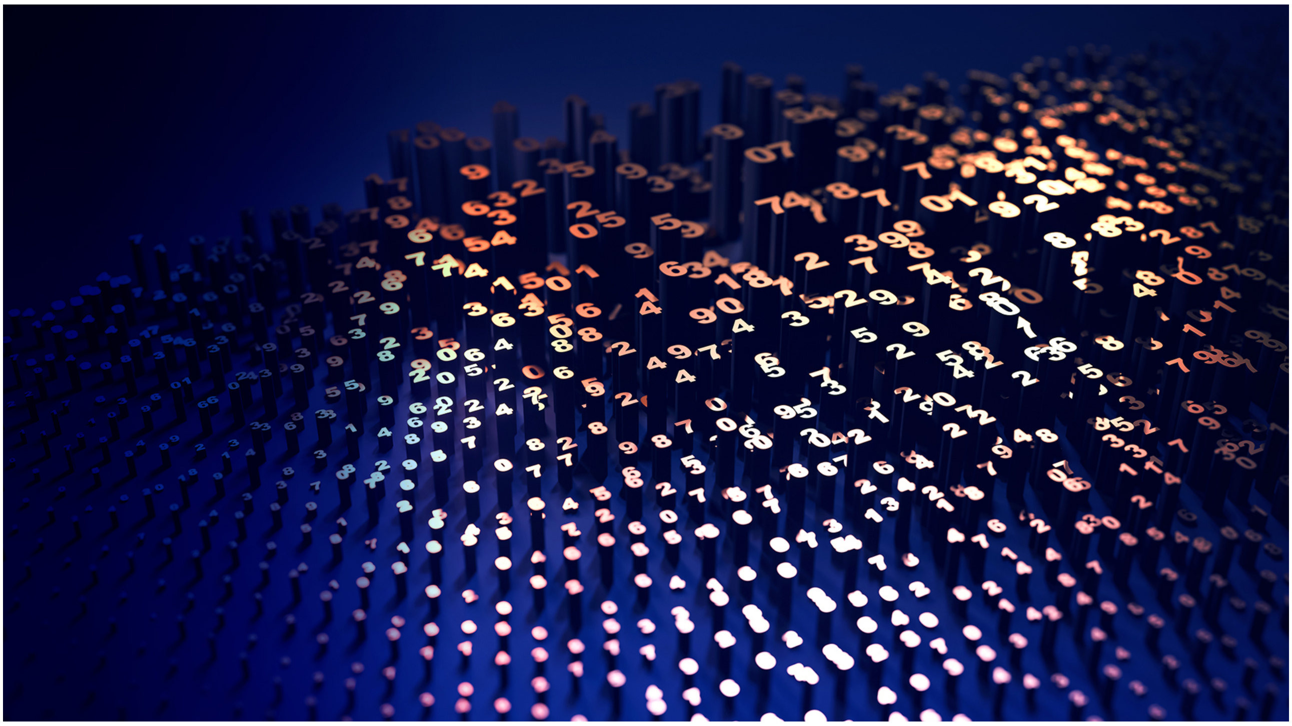
From probability to proprietary factors, Amadeo Alentorn, lead investment manager, Jupiter Systematic Equities, points out some highlights in the rich tradition of systematic investing.

What we now call systematic investing is built on a long tradition of using mathematics and evidence to guide decisions in uncertain markets. During its long and fascinating history, it has attracted some of the world's most innovative thinkers. To be part of that ongoing tradition, it is worth understanding how the field has evolved and why its history still matters today.



FROM INTUITION TO EQUATIONS

Humans have always taken 'calculated risks', in the broadest sense. A decision about which food to hunt or gather involves instinctive weighing up of risk and reward. Early hunter gatherers faced problems like 'Shall we hunt large game, which gives more energy but at greater risk, or should we gather root vegetables and berries, which is safer?' Economic decisions like this were taken by instinct, shaped by evolution over millennia, and increasingly by knowledge, based on a shared culture.

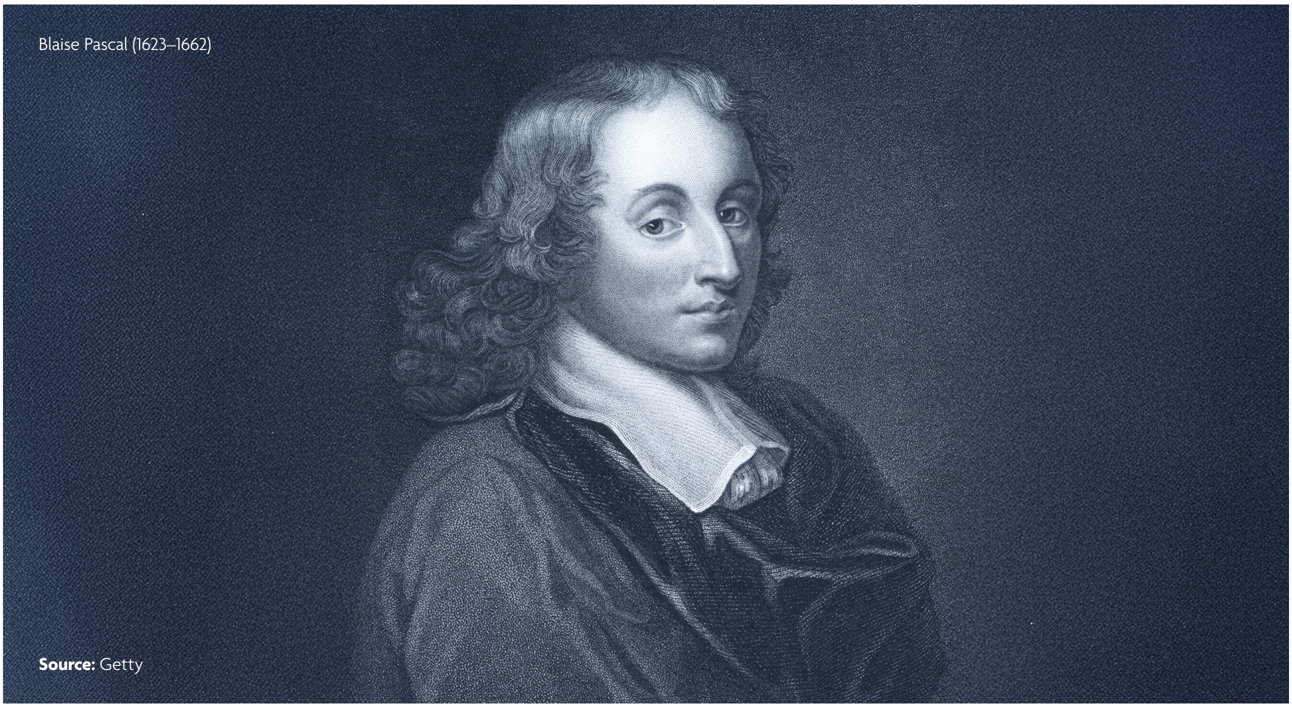
The first known metal coins were minted in Lydia (modern-day Turkey) around 600–610 BCE. For centuries after the invention of money, investing was guided by intuition, reputation, and gut judgment. Merchants took risks based on experience. Bankers relied on relationships to assess credit risk.

Often regarded as the first official stock exchange, the Amsterdam Stock Exchange was established in 1602. (The Antwerp bourse, 1531, predates it for commodities.) Early investors often followed the crowd, sometimes with disastrous results. **Isaac Newton** (1643–1727), perhaps the greatest scientist ever, lost a fortune in the South Sea Bubble of 1720. After the bubble burst and chaos ensued, Newton reportedly said, "I can calculate the motions of the heavenly bodies, but not the madness of men." For Newton and other thinkers of his time, the behaviour of, on the one hand, natural bodies and, on the other, humans (even in aggregate) were seen as entirely different.

THE ORIGINS OF FINANCIAL MATHEMATICS

The intellectual seeds of systematic investing were planted in the 17th century. **Blaise Pascal** (1623–1662) and **Pierre de Fermat** (1601–1665) laid the foundations of probability theory while solving problems in gambling. Pascal's famed correspondence with Fermat in 1654 was prompted by questions from Antoine Gombaud, the Chevalier de Méré—a French nobleman who enjoyed gambling challenges. De Méré brought what was known as the "problem of points" (how to fairly split stakes when a game ends prematurely) to Pascal's attention, which in turn motivated Pascal to develop foundational ideas in probability theory.

Blaise Pascal (1623–1662)



Source: Getty

Swiss mathematician **Jacob Bernoulli** (1655–1705) formalised the law of large numbers. This states that the average of the results obtained from a large number of independent random samples converges to the true value.

Bernoulli's posthumously published seminal work *Ars Conjectandi* (1713) deeply engaged with probability theory—including examples related to games of chance.

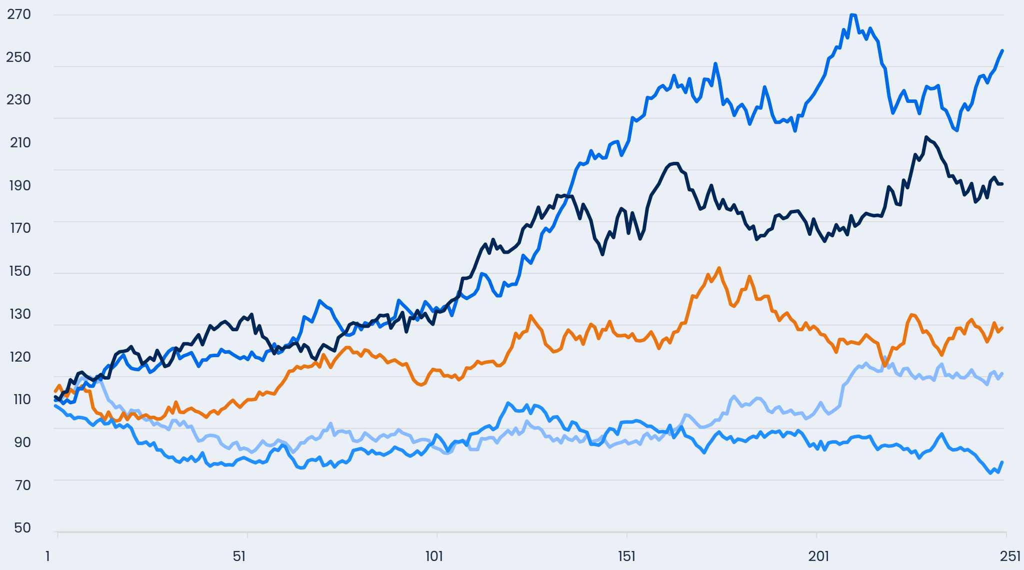
Insurance markets in London and Amsterdam translated these ideas into actuarial practice, pricing maritime risks and life annuities. The link between probability and finance was clear: markets and games of chance both involved uncertainty and statistics. But applying mathematics directly to traded asset prices would take another 200 years.

Louis Bachelier (1870–1946) was a French mathematician working largely in obscurity. His 1900 doctoral thesis, *Théorie de la Spéculation*, introduced ideas that were far ahead of his time. It was not well received because he applied mathematical ideas to financial markets, which was unusual. His later book, *Le jeu, la chance et le hazard* (Games, Chance, and Randomness), published in 1914, led to unpaid lectures at the Sorbonne. Bachelier modelled stock prices as a random walk, anticipating Brownian motion (formalised by Einstein five years later, in 1905), and laying the conceptual groundwork for modern stochastic calculus. The idea later became a centrepiece of the Efficient Market Hypothesis.

WHY BACHELIER MATTERS TODAY

Every systematic or quant model assumes some statistical structure of price movements—whether Gaussian or not. Bachelier's intuition that randomness could be mathematically described was the first spark of what became modern systematic investing.

RANDOM WALKS OF A SIMULATED PRICE PROCESS



Modelling stock returns as a random walk. The five simulated paths are generated by compounding random log-returns with a specified volatility and upward drift, illustrating how prices can evolve stochastically over time.

Source: Jupiter. For illustrative purposes only.

BUILDING THE MODERN PORTFOLIO FRAMEWORK

During the 1950s to the 1970s the mathematical foundations of portfolio theory were discovered. Four figures stand out: Harry Markowitz, William Sharpe, and Eugene Fama (with Kenneth French joining later). Together, they provided the conceptual scaffolding that still supports portfolio construction and asset allocation today.

A graduate student at the University of Chicago in the early 1950s, **Harry Markowitz** (1927–2023) published his seminal paper *Portfolio Selection* in 1952. He would later share the Nobel Prize in Economics (1990). He introduced mean-variance optimisation. Instead of selecting individual securities based on expected return, investors could view portfolios as risk/return bundles. Variance (volatility) measured risk; covariance across assets allowed for diversification benefits. Investors still frame allocation around the efficient frontier. Risk budgeting, multi-asset diversification, and even risk-parity funds all trace back to Markowitz's fundamental insight, that portfolios, not individual securities, are the units of rational investment.

William Sharpe (1934–) refined Markowitz's ideas into a general equilibrium theory. His work in the 1960s would become foundational. His Capital Asset Pricing Model (CAPM) formalised the idea that only systematic risk (beta) is priced, while idiosyncratic risk can be diversified away. CAPM was criticised by **Stephen Ross** (1944–2017) for only considering one factor: market beta. Ross correctly argued that this was too restrictive. Ross developed Arbitrage Pricing Theory, which allows for multiple factors.

Sharpe also gave us the Sharpe Ratio, still the most widely used measure of risk-adjusted returns today. The Sharpe Ratio measures the expected value of an asset minus the risk-free rate, all divided by the standard deviation of the asset's excess return.

Eugene Fama (1939–), a University of Chicago economist, advanced the Efficient Market Hypothesis in the 1960s. Kenneth French (1944–) became his collaborator, and helped extend the framework. The Efficient Market Hypothesis claims that prices incorporate all available information; excess returns are therefore unpredictable. This immensely influential idea inspired the rise of passive investing: if stock prices cannot be predicted, why not just track the market, especially if you can do so cheaply?

THE RISE OF FACTOR INVESTING

Fama and French also developed the Three-Factor Model in 1993. This says that returns are explained by market risk, size (small minus big), and value (high book-to-market minus low). Fama and French used a multivariate linear regression model. It hypothesises that returns can be explained as linear combinations of several distinct factors. Going back a bit, linear regression was developed by statisticians such as **Karl Pearson** (1857–1936) and **R. A. Fisher** (1890–1962). Its roots date even further back to **Sir Francis Galton** (1822–1911), **Adrien-Marie Legendre** (1752–1833) and **Carl Friedrich Gauss** (1777–1855).

Fama and French later expanded their model to five factors (adding profitability and investment). Modern factor investing—from generic smart beta to more sophisticated systematic equity strategies—can be traced back to Fama and French.

Arguably, Markowitz, Sharpe, Fama and French did more than anyone to transform investing from art to science. They gave investors a framework for efficient diversification, a model of risk premia, and a rationale for systematic factor exposures. Although our own approach goes well beyond generic factors, and strongly rejects the Efficient Market Hypothesis, we are deeply indebted to their ideas. Despite challenges (fat tails, behavioural anomalies, crises), their modern portfolio framework remains the intellectual bedrock of quantitative finance.

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>
> **AMADEO ALENTORN**
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> Jupiter Systematic Equities

DERIVATIVES AND RISK

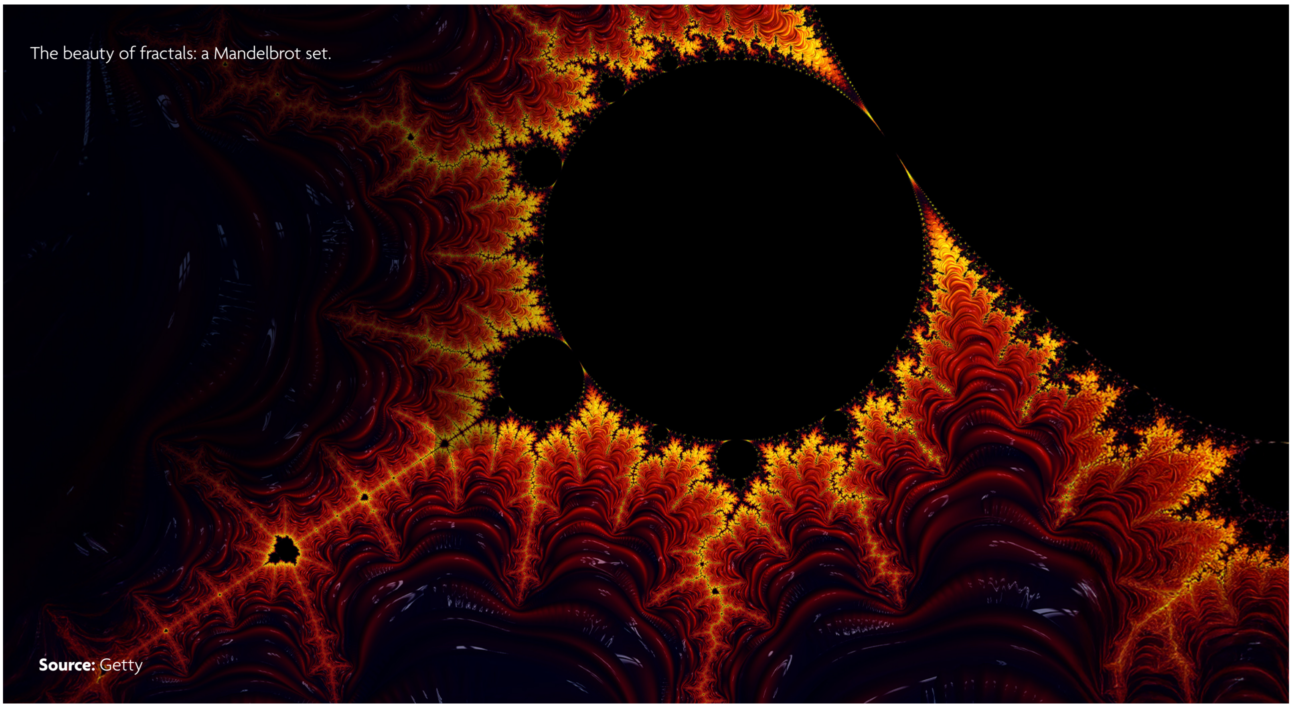
In 1973, economists **Fischer Black** (1938–1995), **Myron Scholes** (1941–) and **Robert C. Merton** (1944–), developed the Black–Scholes–Merton option pricing model, often known simply as the Black–Scholes equation. Using stochastic calculus, they showed how derivatives could be priced and hedged based on underlying volatility. Entire derivatives markets—from listed options to exotic structured products—depend on this framework, or developments of it. Risk-neutral pricing, hedging, and the Greeks are central to risk management.

As often in the history of finance (think back to Newton's South Sea bubble disaster), there is a cautionary tale. Scholes and Merton joined the firm Long-Term Capital Management (LTCM) to put their theories into practice. Scholes and Merton won the Nobel prize in 1997. In 1998, LTCM collapsed due to leverage and underestimated correlations. A decade later, despite the new risk mathematics, the Global Financial Crisis (2007–2009) showed a failure to capture systemic risk in structured products based on mortgage-backed securities.

CRACKS IN THE EFFICIENT MARKET HYPOTHESIS

Benoît Mandelbrot (1924–2010) was one of the most original mathematicians ever. He pioneered fractal geometry and developed the concepts of roughness and self-similarity. Many natural phenomena are fractals: trees, coastlines, clouds, seashells, lungs, etc. Fractal characteristics are also found in economic phenomena, such as markets.

Mandelbrot had a keen interest in real-world markets, and introduced fractal geometry and fat-tailed distributions into finance. He showed that price changes exhibit leptokurtosis (extreme moves more likely than Gaussian assumptions allow). Tail-risk hedging, stress testing, and extreme-value theory all stem from Mandelbrot's critique of Gaussian finance.



The beauty of fractals: a Mandelbrot set.

Source: Getty

Mandelbrot's work inspired the development of econophysics, an interdisciplinary field drawing ideas from physics, especially statistical mechanics, and applying them to financial markets. Econophysics views markets as complex, self-organising systems governed by scaling laws and non-Gaussian statistics. **H. Eugene Stanley** (1941–) is one physicist who has made a key contribution to this emerging field.

Another assault on Gaussian finance came from a different direction. While the modern portfolio framework and the Efficient Market Hypothesis suggested markets are informationally efficient, a new intellectual movement began to challenge that orthodoxy.

Behavioural finance emerged in the 1980s and 1990s, marrying psychology with economics to explain persistent anomalies that classical finance could not.

Robert J. Shiller (1946–), a Yale economist and Nobel laureate (2013, shared with Fama and Hansen), wrote *Irrational Exuberance* (2000, 2005, 2015 editions). The first edition (2000) warned of the danger from surging tech stocks before the dotcom bubble burst. The second edition of the book, published in 2005, sounded the alarm on the US housing market – another bubble.

Shiller demonstrated that stock market volatility could not be explained by fundamentals alone. He pointed out that narrative, herd behaviour, and feedback loops drive bubbles and crashes. His **Cyclically Adjusted Price/Earnings ratio (CAPE)** remains a widely followed valuation measure. Shiller's work provides a systematic way to identify market overvaluation.

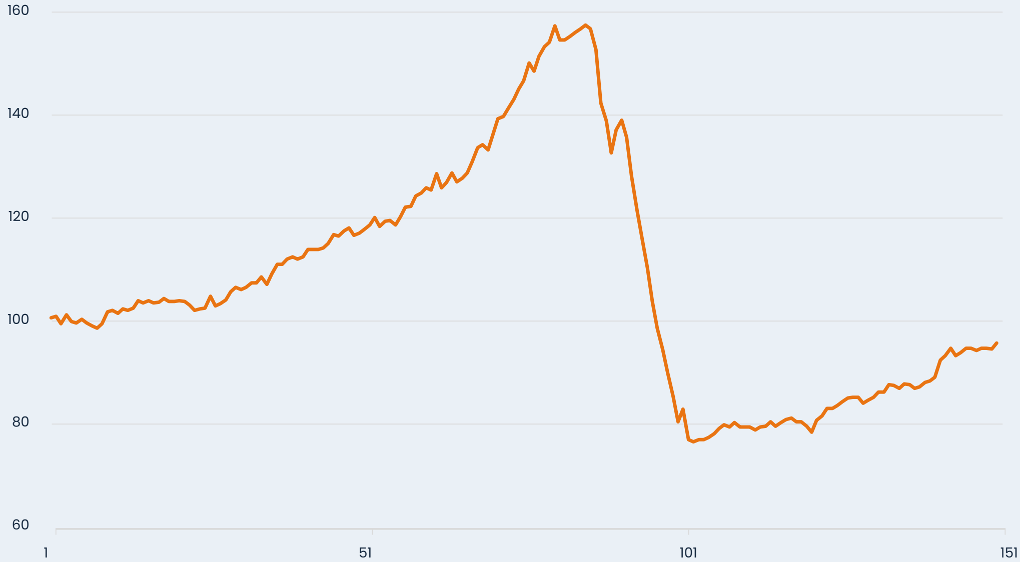
Richard H. Thaler (1945–), a University of Chicago economist and Nobel laureate, was, along with Shiller, one of the founders of behavioural economics. Some of his key insights include **mental accounting, loss aversion, and the endowment effect,** which show that investors tend to behave irrationally. In 2008, he co-authored with Cass Sunstein the book *Nudge*, which applies behavioural insights to policy. Thaler's work challenges the notion of rational expectations.

Two other important figures in behavioural economics are **Daniel Kahneman** (1934–2024) and **Amos Tversky** (1937–1996). Together they developed prospect theory, which aims to explain irrational human economic choices.

ARE MARKETS EFFICIENT?

The **Efficient Market Hypothesis,** developed by Fama, holds that stock prices reflect all known information; and anomalies are statistical noise. The **Behavioural View,** developed by Shiller, Thaler, Kahneman and Tversky, disagrees. The Behavioural View holds that human psychology drives systematic mispricing—momentum, overreaction, underreaction, bubbles, and crashes. It is hard for the Efficient Market Hypothesis to explain convincingly how bubbles and crashes develop.

STYLISED BUBBLE-CRASH-RECOVERY CYCLE



Stylised illustration of a bubble–crash–recovery cycle. The simulated series is generated in phases: a steady compounding growth period, an accelerated drift with added volatility to mimic exuberance, a sharp deterministic downturn to represent the crash, and a slower stochastic rebound. These phases reflect behavioural dynamics such as herd buying, overreaction at the peak, panic selling during the crash, and gradual recovery.

Source: Jupiter. For illustrative purposes only.

Behavioural finance was a major advance, complementing and correcting earlier simpler, more abstract, models. In our view, markets are not purely efficient; biases create exploitable patterns. Investor psychology is a key element in understanding how markets evolve, and also how companies are managed. Systematic strategies such as momentum, quality, and value can be understood through a behavioural lens. **Momentum and reversal** strategies derive from behavioural patterns (underreaction/overreaction). **Style cycles** (such as value vs. growth) often reflect investor sentiment shifts, not just fundamentals. The Jupiter systematic process sides with the Behavioural View and against the Efficient Market Hypothesis. In our view, flows, biases, and heuristics can drive mispricing, creating opportunities for factor-based strategies. We incorporate sentiment measures into our models alongside fundamentals.

PROPRIETARY FACTORS AND ALTERNATIVE DATA

While the Fama–French factor models gave a structured view of equity premia, the past few decades have seen an explosion in the hunt for **proprietary factors** and the incorporation of **alternative data** into quantitative research. This reflects both the commoditisation of standard factor exposures and the relentless search for new sources of alpha.

By the 2010s, generic size, value, momentum, and quality factors were widely available through ETFs and index products. In addition, academic research claimed to find hundreds of other factors, and their proliferation led to the unintended emergence of a “factor zoo”. On closer inspection, many of these so-called factors turned out to be correlated, data-mined or unstable.

In the Jupiter systematic team, our approach has been to develop proprietary factors: developments of traditional generic factors that, in our view, provide an edge. We have also ensured that all the factors we employ make sense intuitively: they are not mere statistical artifacts. They make economic sense. We seek to engineer factors that are robust, capacity-aware, and less easily arbitraged.

There has also been an upswing in the variety and availability of **alternative data,** meaning data sources outside traditional financial statements and price histories. It includes credit card transaction data, satellite imagery (e.g., retail parking lots, oil storage tanks), supply chain and shipping data, web-scraped data (e.g. job postings, consumer reviews), and a variety of natural language corpora (e.g. earnings call transcripts, regulatory filings, social media). Alternative data can provide timely, granular insights.

We use alternative data in our own process. For example, we apply Natural Language Processing to earnings call transcripts. We recently introduced a new enhancement based on analysing data about patents. Companies’ research and development expenditure is more likely to be effective if it leads to the filing of patents.

The history of systematic investing is far from over. New techniques and data are opening up fresh opportunities to harness more alpha from markets, building on the systematic research work we have been pursuing for more than 20 years. Today, topics we are researching, together with our academic consultants, include econophysics and artificial intelligence, among others. We look forward to informing clients about the results of our research in due course.

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1720 South Sea Bubble

1900 Bachelier's doctoral thesis, *Théorie de la Spéculation*

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1960s CAPM and the Efficient Market Hypothesis

1973 Black–Scholes equation

1988 LTCM collapsed

1993 Fama and French Three-Factor Model

1999 Mantegna and Stanley *An Introduction to Econophysics* published

2000 Shiller's *Irrational Exuberance* published

2004 Mandelbrot's *The Misbehavior of Markets* published

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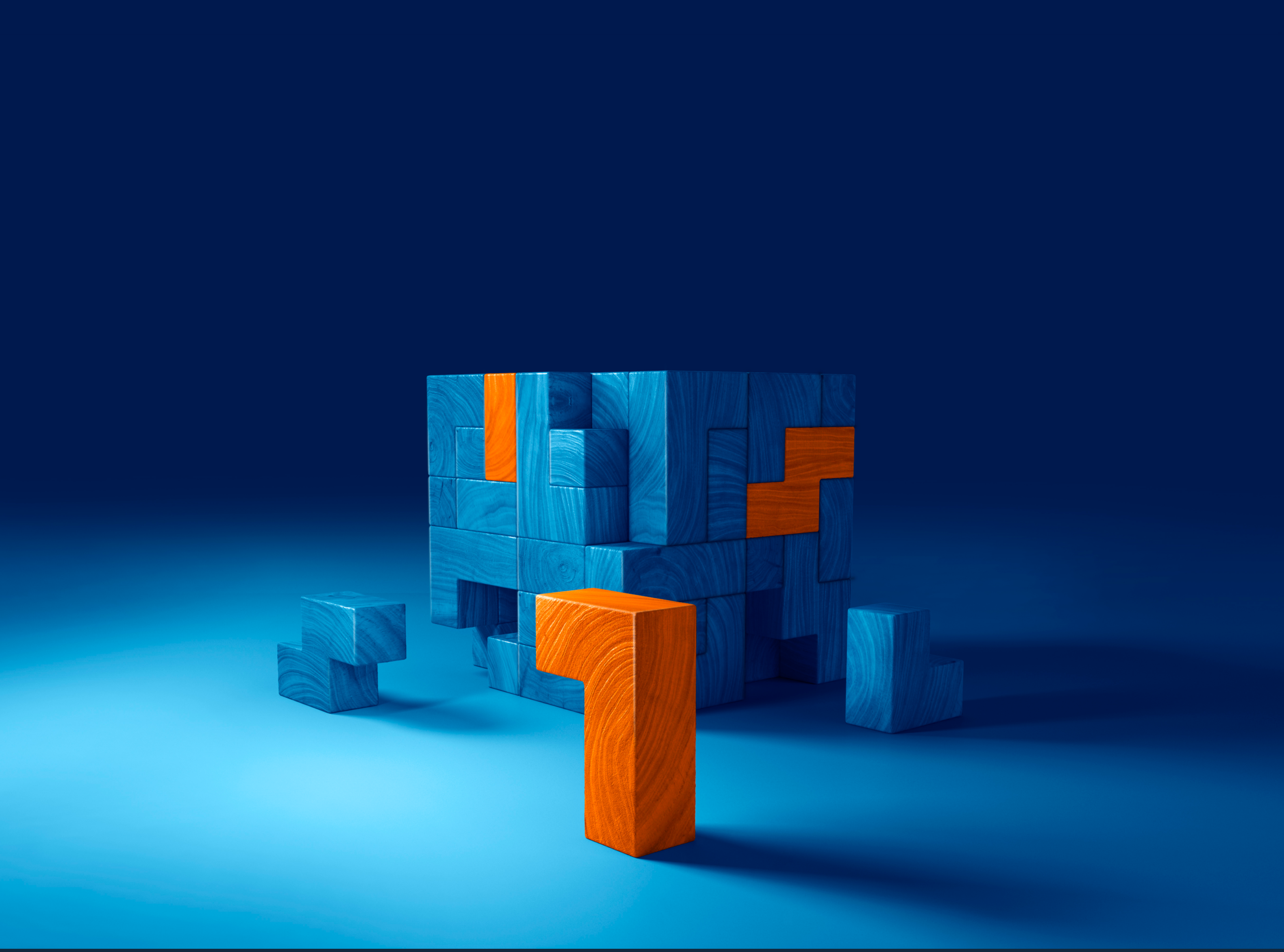
2010s factor zoo and alternative data

2020s artificial intelligence

Source: Jupiter. September 2025



The value of active minds – independent thinking: *A key feature of Jupiter's investment approach is that we eschew the adoption of a house view, instead preferring to allow our specialist fund managers to formulate their own opinions on their asset class. As a result, it should be noted that any views expressed – including on matters relating to environmental, social and governance considerations – are those of the author(s), and may differ from views held by other Jupiter investment professionals.*

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