Voya Equity Machine Intelligence: Human *Plus* Machine

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Voya's Equity Machine Intelligence team aims to take emotion out of the investment process to deliver alpha that is uncorrelated to more traditional equity strategies.

Executive Summary

While humans still oversee the vast majority of investment decisions, advancements in machine learning technology bring several key benefits to the world of investing, including the ability to:

- Systematically apply the rigor of fundamental research to a wide breadth of stocks
- Identify market inefficiencies and take action when a great stock becomes temporarily undervalued
- Create a portfolio that is highly customizable to meet specific client objectives in a cost-effective manner

In a crowded world where active equity strategies look increasingly similar to each other, we believe machine learning's potential to deliver return streams that are less correlated to traditional equity approaches will become a particularly valuable tool for investors.

The Challenge of Investing

"I can calculate the motion of heavenly bodies, but not the madness of men." - Isaac Newton (after he lost his fortune speculating in the South Sea Bubble, more than $5m in today's dollars)

Really good investment opportunities are ephemeral and rare. Successful investing requires taking swift and decisive action when a great stock becomes temporarily undervalued – one must take on more risk when market volatility provides a 'target rich' environment. That is, the task of an investor is to constantly search for mis-priced assets and pounce when the market becomes irrational. The market is mostly efficient rather than always efficient - and the distinction makes all the difference in the world.

Some humans can apply the discipline needed to successfully pick stocks. However, even the most successful stock picker makes mistakes along the way. By definition, successful investing over the long-term requires standing apart from the crowd. This is extremely uncomfortable, and not just in a metaphysical way. Learning the rules of the investment game is hard, despite the brain having incredible pattern recognition technology.

Consider other complex tasks like elite chess, driving or flying a plane: if you make a mistake, you know it almost immediately. Feedback is unequivocal. The rules are clear. Error rates, consequently, are very low. Rules of the game for the stock market, however, are hidden in randomness, noise and further obscured by behavioral biases and emotional responses. Great investments require a combination of super-human patience married with aggressive opportunism.

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Rules of the Game: Follow the Map of Tails to Stock-Picking Success
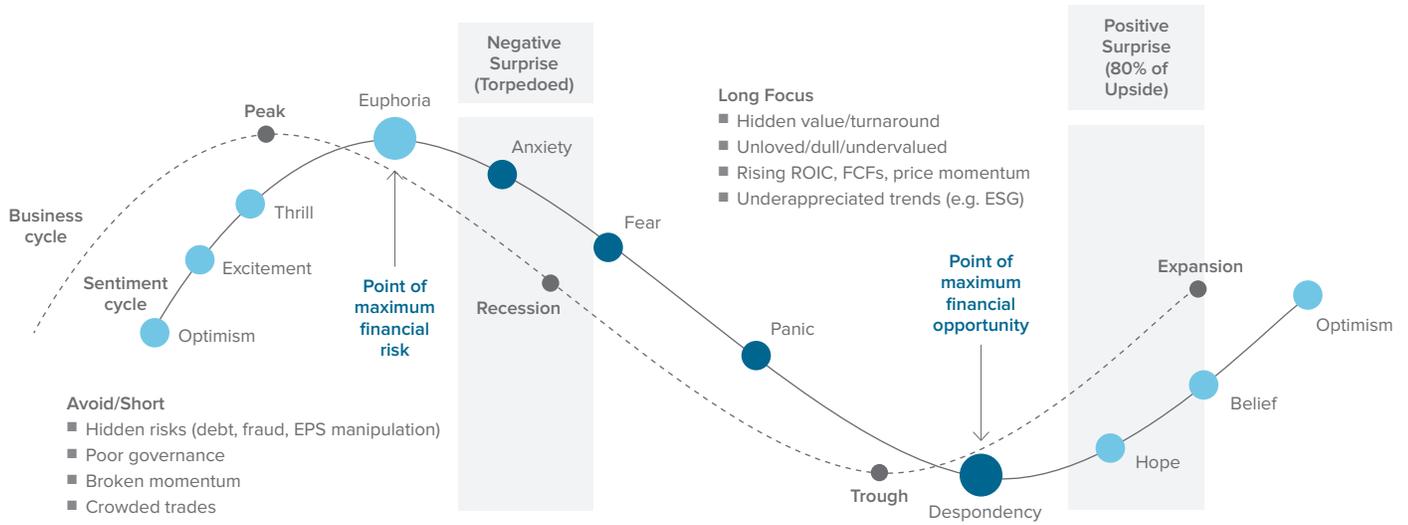
Source: Voya Investment Management. For illustrative purposes only.

Innovation Makes the Impossible Possible – and Time is of the Essence

"The stock market is a device for transferring money from the impatient to the patient." -Warren Buffett

So how to respond quickly and decisively to rare and time-limited investment opportunities? More importantly, how to avoid catastrophic investment errors? There are tens of thousands of data-points at a company level that could be assessed to make a determination. With this foundation, machines are the perfect partner with their ability to learn to emulate the skill of the world's best stock pickers.

The power of human plus machine is particularly valuable in the context of an increasingly concentrated and correlated equity market where true alpha opportunities are not only exceedingly rare, but also disappear very quickly.

Market volatility (even the extreme kind) is often justified by the fundamentals. The dramatic COVID-19 panic of March 2020 was triggered by re-pricing of tail-risk in the face of pervasive uncertainty. Nevertheless, investor emotions and institutional imperatives often lead to large over-shoots, as we saw in 2020.
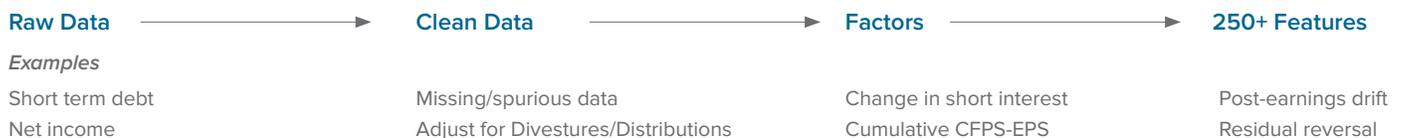
Against this backdrop, machine learning technology delivers the virtue of patience and the ability to act quickly and decisively when opportunities arise. This combination allows investors to access return streams that, over the long term, have the potential to be less correlated to other active equity strategies.

A Modern Approach to Investing

Voya IM's Equity Machine Intelligence (EMI) team uses machines to learn - and consistently apply - the rules of the game. That is, to apply machine learning to the task of finding persistent patterns in company fundamental data. EMI's systematic approach to stock-selection applies various machine learning approaches. Instead of a single 'magic algo', there are 26 virtual analysts that compete to select stocks and 45 virtual traders who help cut losses and time trades. It's an ensembled and layered approach.

Our virtual analysts have the same starting point as everyone else: publicly available information which, in aggregate, comprises 10,000+ unique data points per company. A key advantage the machine has in competing against humans is that it can assess the entire stock universe rapidly. However, unlike traditional quant strategies that can have wide breadth but limited depth, not only can machine-learning technology quickly assess information, it can make sense of it, too.

From Data to Features: Separating Information from Noise

Raw Data	→	Clean Data	→	Factors	→	250+ Features
Examples						
Short term debt		Missing/spurious data		Change in short interest		Post-earnings drift
Net income		Adjust for Divestures/Distributions		Cumulative CFPS-EPS		Residual reversal

Source: Voya Investment Management. For illustrative purposes only.

Our investment process is underpinned by a set of more than 250 features; expert systems that transform messy raw data into useable information. Features provide a deep, holistic view of each company and are applied across multiple forecast horizons.

Identifying Features: Going Beyond Factors
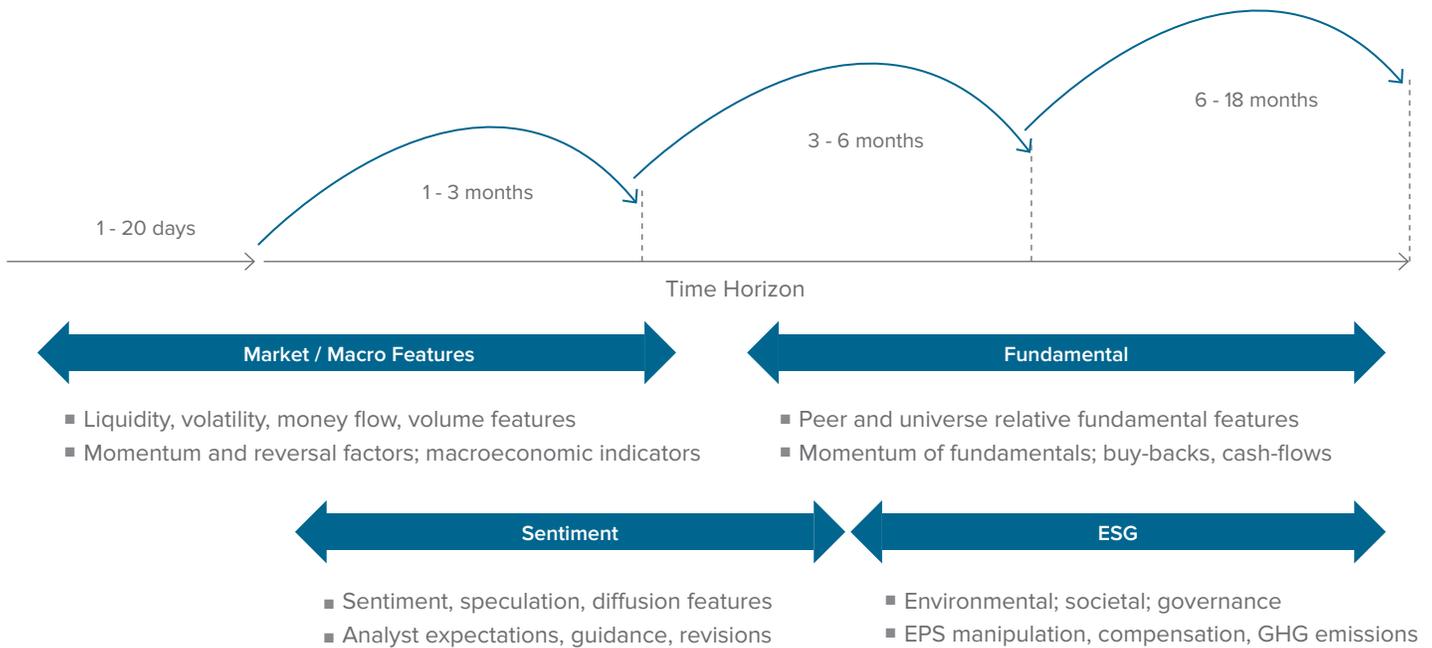
Source: Voya Investment Management. For illustrative purposes only.

Within this stock selection framework, our virtual analysts become "rejection machines", saying "no" to more than 96% of stocks - rather than analyzing a few and getting to yes. When the system does finally say yes, our virtual analyst's decision is unemotional and based on sustainable patterns in 20+ years of fundamental, ESG and sentiment data.

Not all buy recommendations from the virtual analysts will make it into the portfolio at that time. Prior to purchase, all buys and sells must pass through our team of 45 virtual traders, who analyze shorter term top-down data (e.g. price and sentiment) to determine the entry/exit timing of each stock as well as position sizing. Again, the decision is void of emotion, allowing the virtual traders to take positions in stocks that may be otherwise uncomfortable to portfolio managers and avoid chasing after crowded trades. As a result, the strategy does not have static style or factor biases. This leads to a portfolio that behaves differently than that of other traditional active managers. Moreover, the anti-crowding, contrarian approach to trading results in a return stream that is uncorrelated to both active and passive equity funds.

Combining the Best of Human and Machine

"Machines are not prophets; machines can solve a game or goal. They can make mistakes, but when you look at the average quality of the moves it's fairly consistent."

- Garry Kasparov, Former World Chess Champion, Business Insider, 2017

Kasparov is right – and he is a huge convert – when IBM's Deep Blue defeated him 20 years ago in May 1997, he referred to it as a "$10 million alarm clock". And the pace has only accelerated. In the face of defeat at chess, Piet Hut, from the Institute for Advanced Studies at Princeton stated, *"It may be 100 years before a computer beats humans at Go … maybe even longer."* Less than 10 years later, AlphaGo made a decision (on its 37th move) that baffled all the experts and led to "the machine" defeating Lee Sedol, one of the most decorated Go players alive. AlphaGo's lead researcher placed the odds of a human making the same move at 1-in-10,000, yet it ultimately resulted in victory. AlphaGo Zero, released in 2017, surpassed all prior versions in 40 days by playing games against itself starting from completely random play, rather than being trained on thousands of human amateur and professional games. Zero is arguably the strongest Go player in history, because it is *no longer constrained by the limits of human knowledge.* Go is very complex, and to play without errors is nearly impossible. But machines may make fewer mistakes than humans.

To be clear, even the best machine intelligence system is not really 'smarter than humans' in a pure sense. It just makes fewer mistakes.

However, that doesn't make them infallible, magic or omnipotent. In a sense this brings us full circle – back from the machine to the human. In all of this, ***no matter how developed machine intelligence applications become, it is truly humanity that is developing***. The real intelligence lies in humans for innovating, rather than in AI's raw capabilities. As Kasparov said, "Weak human + machine + better process was superior to a strong computer alone and, more remarkably, superior to a strong human + machine + inferior process."

Conclusion: EMI Brings the Depth of Fundamental Research and the Breadth of Traditional Quant

From self-driving cars to the defeat of Go champions, the world has witnessed an enormous wave of innovation in machine learning over the last decade. In investment management, we view machine learning as the bridge between traditionally disparate fundamental and quantitative disciplines. Through the Equity Machine Intelligence team, Voya's Quantitative Equity Platform intends to lead the way in combining the best of traditional quant/human processes with advanced artificial intelligence and machine learning techniques, increasingly seen as the next frontier for asset managers. Our aim is to deliver specialized investment strategies that combine the breadth and dynamism of quantitative equity investing with the depth and rigor normally reserved for top human managers.

The end result is an investment process that is highly customizable to meet specific client objectives and that seeks to deliver opportunistic alpha along with strong diversifying benefits that come with a truly differentiated approach.

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