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A New Approach for Systematic Strategies*

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Traditional systematic investment strategies often struggle to adapt to changing market conditions and shifts in the economic environment. This note introduces MARS (Macro Allocation and Risk System), a framework based on Bayesian statistics and modern macroeconomics, that jointly forecasts asset returns and constructs optimal dynamic portfolios. We explain how we jointly model asset prices and macroeconomic variables to capture their interdependencies and evolving dynamics. By integrating nowcasting techniques and leveraging neural networks for dynamic portfolio optimization, MARS offers a more robust and adaptable framework for investment. This approach is designed to enhance forecasting accuracy, support scenario analysis, and improve risk management, providing a comprehensive solution for navigating the complexities of modern financial markets.

Systematic strategies that offer a structured, quantitative approach to making investment decisions, have long been integral to the financial industry. Traditionally, these strategies have relied on individual asset signals and a series of ad-hoc procedures for portfolio construction. While this approach is grounded in practical experience, it has notable limitations, particularly in adapting to the changing market conditions of the post-pandemic world and incorporating a comprehensive set of macroeconomic factors. We present an alternative methodology grounded in Bayesian statistics and modern macroeconomics. By jointly modeling price and non-price data, utilising nowcasting techniques, and leveraging neural networks for dynamic portfolio optimisation, we aim to create a more robust, transparent, and adaptable framework for systematic investing.

Limitations of Traditional Systematic Strategies

The conventional approach to building systematic investment strategies typically begins with the identification of a 'signal' for each asset—a time series intended to predict future returns, either derived from transformations of the asset's own historical performance, or from some other source (Figure 1). Once these signals are established, they undergo several processing steps to construct the overall portfolio. These steps include scaling signals by asset volatility to normalise risk exposure, applying caps and floors to limit excessive positions, adjusting the sensitivity of signals, and filtering or smoothing to reduce excessive trading and transaction costs. Finally, asset-signal pairs are ranked and weighted to construct a portfolio, often grouped by asset class to prevent over-concentration in correlated assets.

While these methods are rooted in practical experience, they involve arbitrary choices at each step and lack a rigorous theoretical foundation. The strategies are typically evaluated based on their performance over available historical data, which is often limited in length and may not adequately represent future market conditions due to regime changes and market evolution. This reliance on historical data raises concerns about overfitting, where

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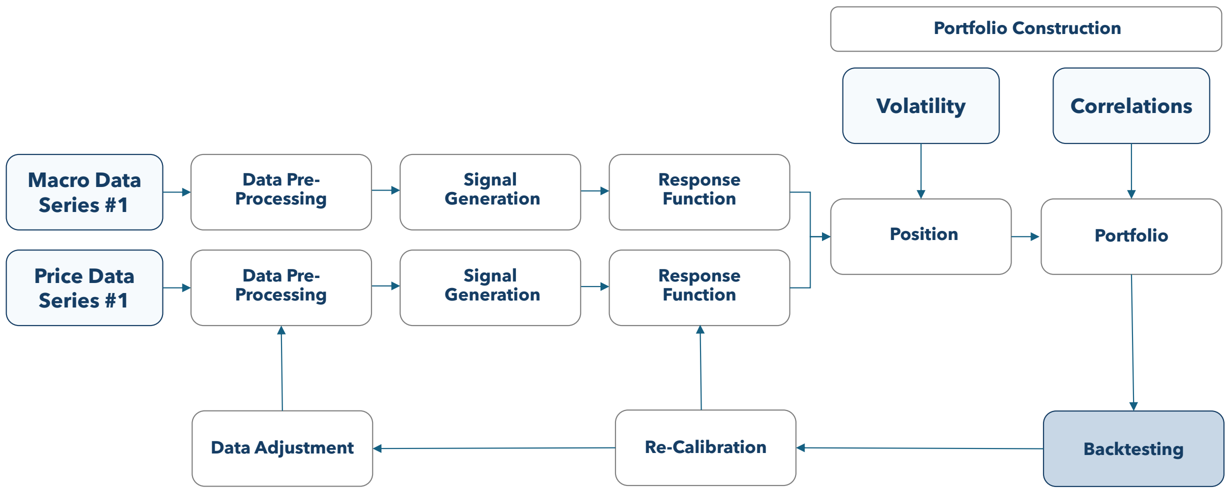
Figure 1: Traditional Approach to Systematic Strategies



Notes: The traditional approach to systematic strategy construction involves combining different 'signals', each of which has been independently pre-processed, and making a series of ad-hoc steps that end with a portfolio that 'looks right' in the backtest. Source: Fulcrum Asset Management LLP. For illustrative purposes only.

a model performs well on past data but fails to generalise to new, unseen data. Traditionally quantitative analysts try to limit the number of parameters in a model to avoid overfitting, but this can result in models that are insufficiently flexible to adapt to changing market dynamics. The ad-hoc nature of these methods also makes it difficult to understand the underlying reasons for the strategy's performance, limiting the ability to perform meaningful scenario analysis or stress testing.

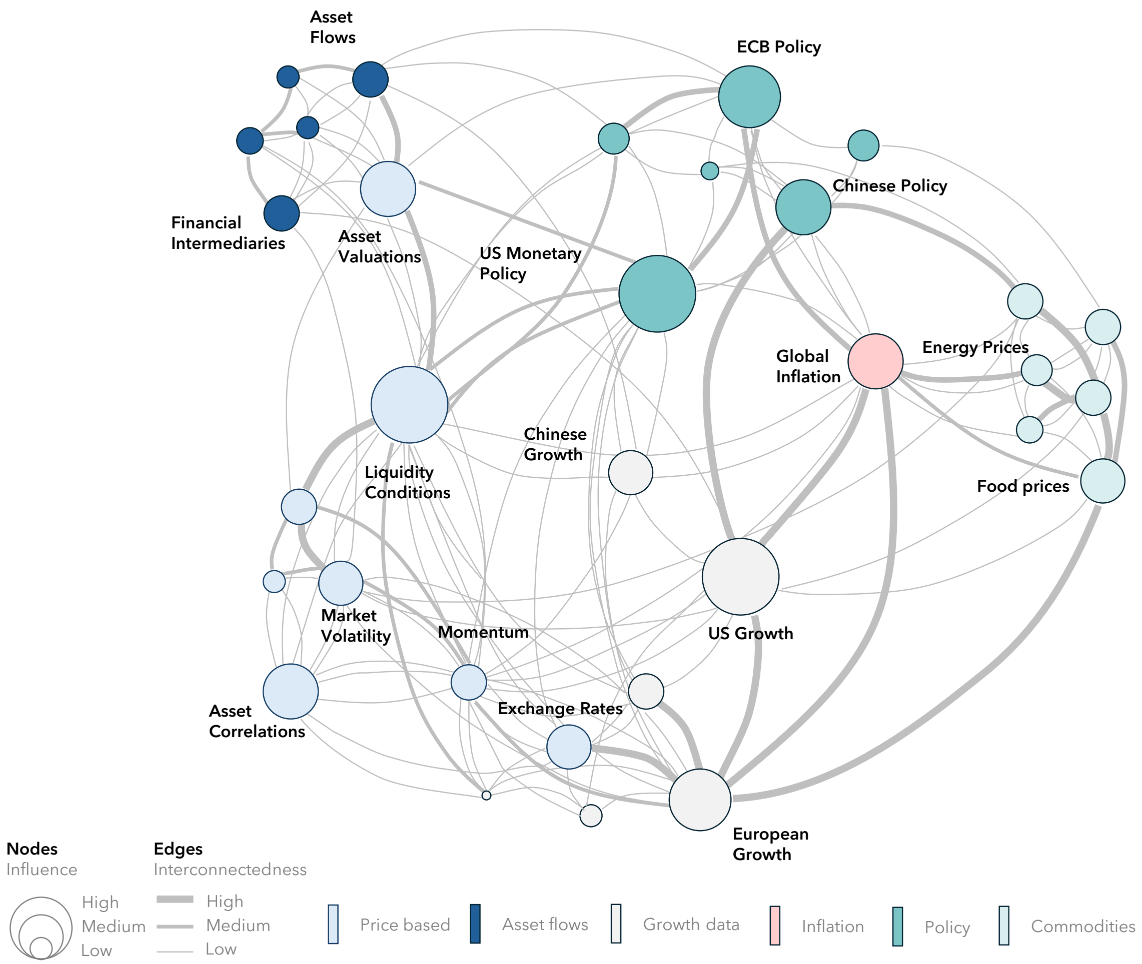
Over the last ten years, the research and development team at Fulcrum has developed a systematic platform for return forecasting and portfolio construction which we call **Macro Allocation and Risk System** (MARS), and is the portfolio engine of our systematic macro strategies. It comprises two key blocks: a Bayesian forecasting engine and a portfolio construction algorithm that leverages neural networks.

A Bayesian, multivariate approach

MARS addresses the limitations of traditional strategy construction by adopting a Bayesian framework and a multivariate perspective on data modelling. Instead of focusing on individual asset signals in isolation, we construct explicit, parametric time series models that characterize the joint probability distribution of a wide array of data. This data includes not only asset returns and prices but also macroeconomic indicators and other variables that may predict asset performance. By treating all relevant data as part of an interconnected system, as illustrated in Figure 2, we acknowledge and model the interdependencies and feedback loops inherent in financial markets.

A Bayesian approach allows us to incorporate prior beliefs and expert knowledge into the modeling process while updating these beliefs as new data become available. This framework favours simpler, more parsimonious models when appropriate, effectively balancing the need for sufficient model

Figure 2: A SYSTEMS APPROACH TO MODELLING MACRO AND FINANCIAL DATA



Notes: The figure illustrates the interconnectedness of global financial drivers, highlighting how shocks to monetary policy or inflation can cascade across markets. Recognising these dynamics is essential for asset management, guiding both risk management and portfolio decisions. Source: Fulcrum Asset Management LLP. For illustration purposes only.

complexity with the risk of overfitting. By emphasising out-of-sample forecasting performance, we aim to build models that generalise well to new data and are robust under changing market conditions.

Grounding our models in modern macroeconomics, which recognises that economies are dynamic, subject to pervasive uncertainty and interconnected, provides a theoretical foundation for understanding how economies evolve over time under the influence of random shocks and policy changes. This allows us to capture the dynamic nature of financial markets and to model features such as time-varying parameters and changing volatilities and correlations. By explicitly accounting for these dynamics, we can better adapt to new conditions and capture predictors that operate at different frequencies or that may sometimes give conflicting signals.

Using Neural Networks to construct more robust portfolios

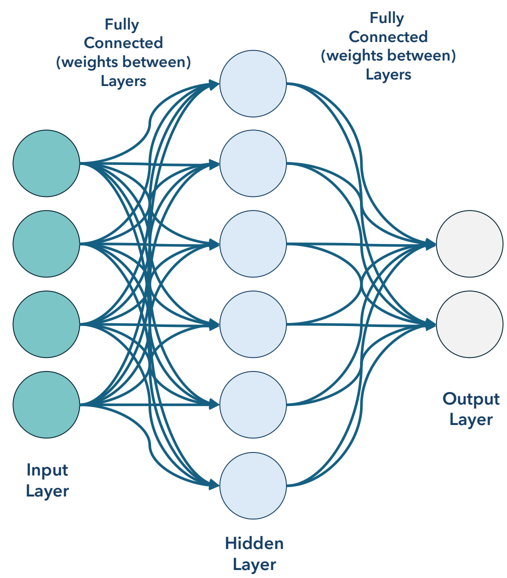
Constructing portfolios within this framework involves solving a dynamic programming problem with many hundreds of 'state variables': data points that enable us to make a decision on the basis of current information. In MARS, there is a forward-looking, utility-maximising agent who makes portfolio choices based on the probabilistic model described above. This agent is aware of the uncertainty surrounding future data values, model parameters, and even the possibility that the model itself may be wrong. This setup requires finding a 'policy function', that maps current state variables to optimal decisions.[1]

Solving this problem is challenging due to the large dimensionality involved: the model may include hundreds of state variables and complex, non-linear constraints, such as limits on ex-ante volatilities or on potential losses. Traditional dynamic programming methods are often unfeasible in this context due to computational constraints. For instance, the classic method of value function iteration would only be applicable to small models with just a handful of assets; while approaches relying on linear approximations would preclude complex risk constraints such as maximum drawdown limits.

To overcome this obstacle, MARS leverages neural networks and modern GPU computation. Neural networks are capable of approximating complex functions and handling high-dimensional inputs efficiently (Figure 3). By training neural networks to approximate the policy function, we can find solutions to the dynamic programming problem that are both accurate and computationally tractable. This approach allows us to handle the complexity of the optimisation problem and to make better investment decisions that adapt to changing market conditions.

Our use of neural networks involves stochastic simulation of many possible future paths for the evolution of the states. By doing this, we can evaluate how the agent's decisions perform across different potential market conditions. This method goes beyond traditional backtesting, which relies solely on historical data that may not capture the full range of future possibilities. The integration of neural networks into portfolio optimisation represents a significant advancement, enabling us to make meaningful progress even with the data constraints inherent in macroeconomics and finance.

Figure 3: Example of a Neural Network



Notes: In the typical neural network architecture, data flows through interconnected layers—from input to hidden to output layers—with weighted connections that adjust through training. Source: Fulcrum Asset Management LLP. For illustration purposes only.

Conclusion

Our approach to building systematic investment strategies represents a significant departure from traditional methods. By grounding our models in Bayesian statistics and modern macroeconomic theory, we can construct a comprehensive and flexible framework that accounts for the complexities of financial markets. The use of nowcasting techniques allows us to process macroeconomic data effectively

[1] Like the operations manual of a submarine, a policy function can be understood as a set of instructions specifying how to respond effectively in various situations, outlining step-by-step actions and procedures.

and to incorporate timely economic insights into our models. Leveraging neural networks for dynamic portfolio optimisation enables us to solve complex optimisation problems that were previously intractable, allowing us to adapt to changing market conditions and to make better-informed investment decisions.

This methodology offers several advantages. It provides transparency by having an explicit model of the joint probability distribution for returns and other variables, enabling us to understand the reasons behind changes in our forecasts as new information becomes available. It also facilitates scenario analysis and stress testing, allowing us to explore how different macroeconomic conditions or policy changes might impact portfolio performance. By serving as a laboratory for exploring different portfolio strategies, we can tailor our approaches to specific investment goals or risk profiles, enhancing the relevance and effectiveness of our strategies.

While our models are more complex than traditional approaches, the Bayesian framework helps manage this complexity by focusing on parameters supported by the data, reducing the risk of overfitting. Using modern statistical and computational techniques, we aim to improve investment outcomes by providing deeper insights and by managing uncertainty more effectively. By acknowledging and embracing the complexities of financial markets, we strive to build strategies that are not only effective but that are also transparent and can adapt to the evolving economic environment.

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