Interpretable, Transparent, and Auditable Machine Learning: An Alternative to Factor Investing

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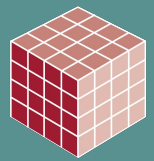


ROTHKO

Problems

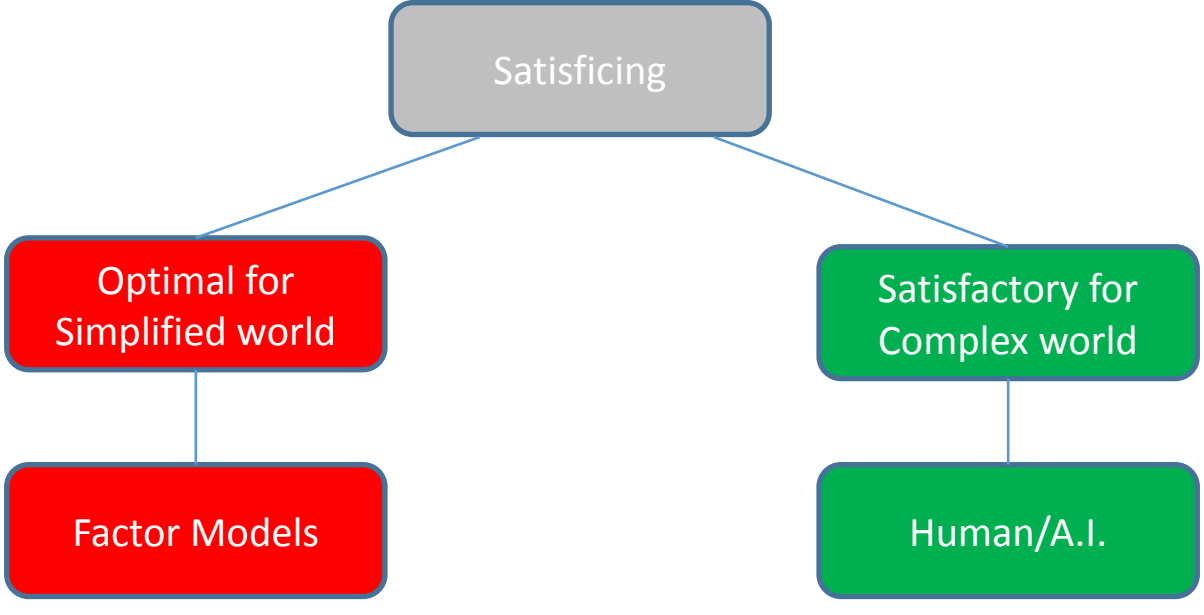
- Factor Investing is a last decade's solution
- There are serious drawbacks of many ML approaches' black-box outcomes and lack of model interpretability

Solution

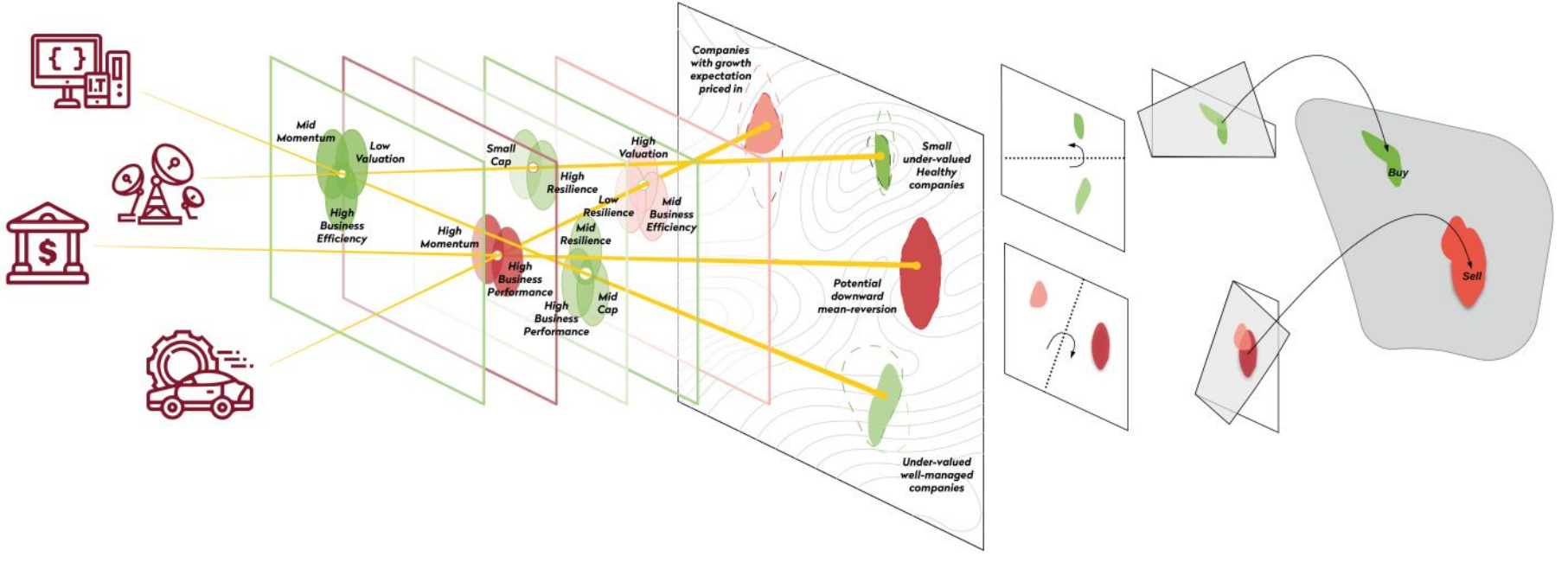
- Symbolic artificial intelligence (SAI) for stock selection, a form of ***satisficing*** decision making, provides an alternative to factor investing and overcomes the interpretability issues of many machine learning (ML) approaches

Motivation: "Finding satisfactory solutions for the complex world"

"*Decision makers can satisfice either by finding optimum solutions for a simplified world, or by finding satisfactory solutions for a more realistic world* (*Herbert Simon, 1979*) "



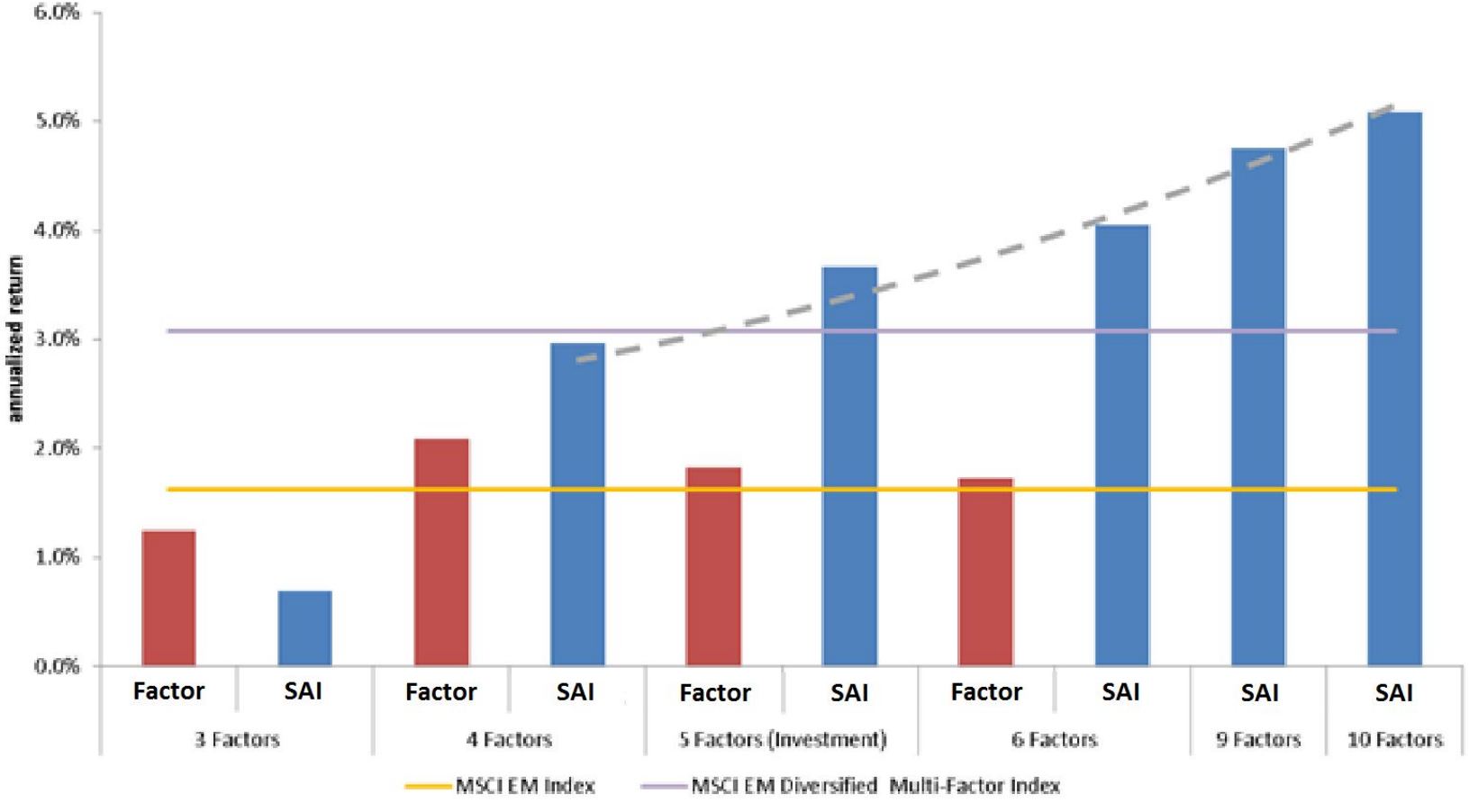
SAI Approaches: Finding Satisfactory Solutions for a More Realistic World



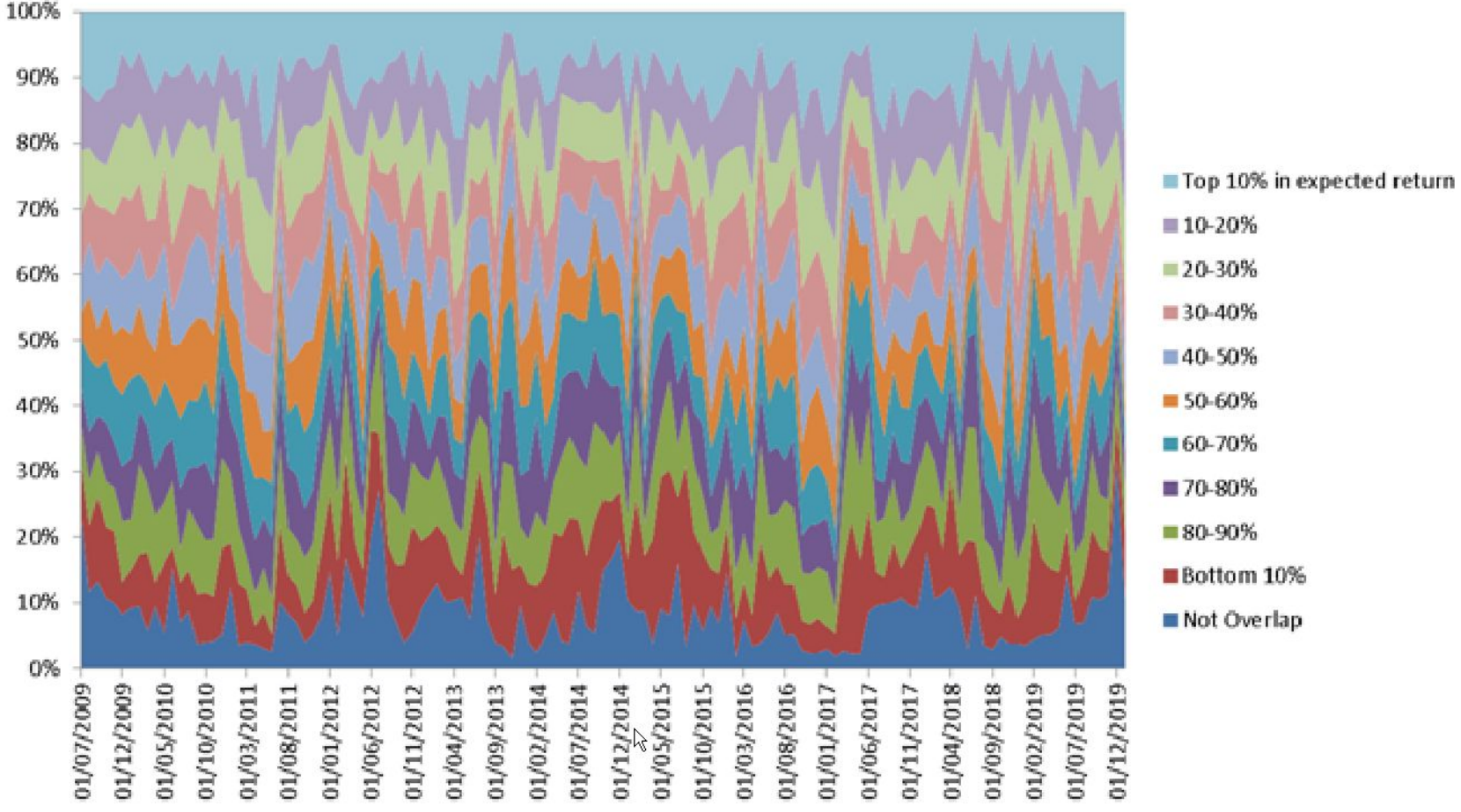
Emerging Markets tests with aligned methodologies

- Emerging markets is used to specifically test these approaches in an inefficient asset class away from the factor crowding noted in developed markets.
- Each SAI and factor approach simulation is aligned in terms of input data provided, equal weighting of positions, training windows, rebalance frequency and other such assumptions.

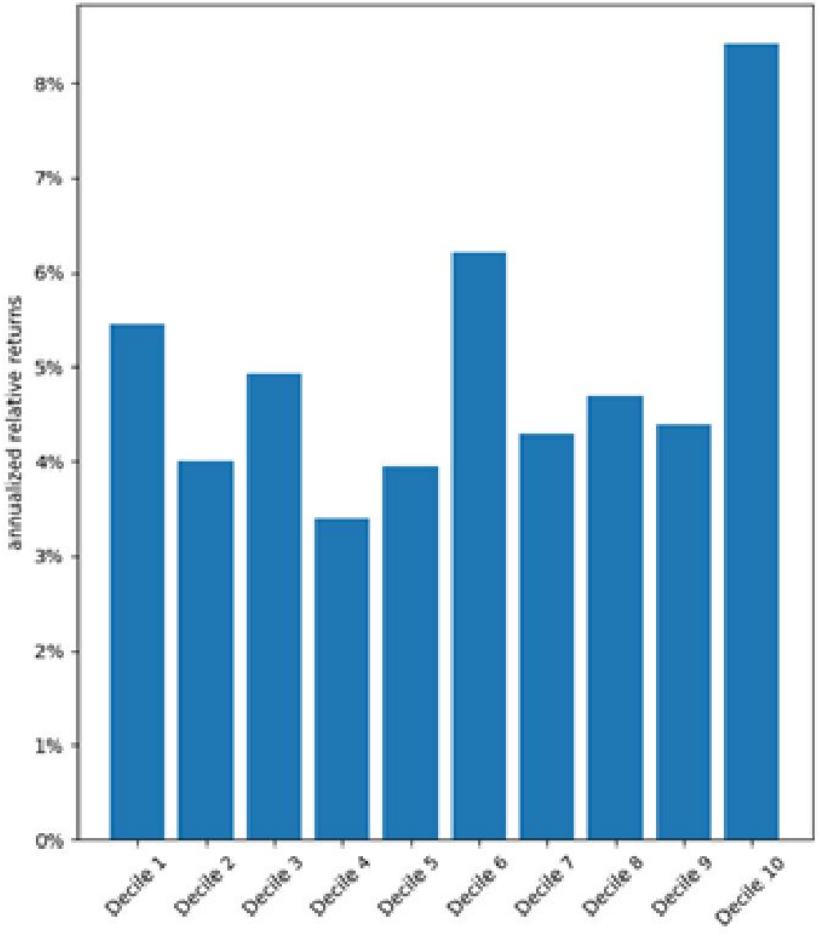
Response to Increasing Number of Inputs



Same drivers, different stocks



Same drivers, different stocks (cont'd)



- The stocks in the SAI portfolio are mapped to where they occur in the ten factor decile portfolios.
- The SAI portfolio stocks found in each of the factor decile portfolios are shown to significantly outperform the non-SAI stocks in each respective factor decile portfolio.

Knowledge Representation

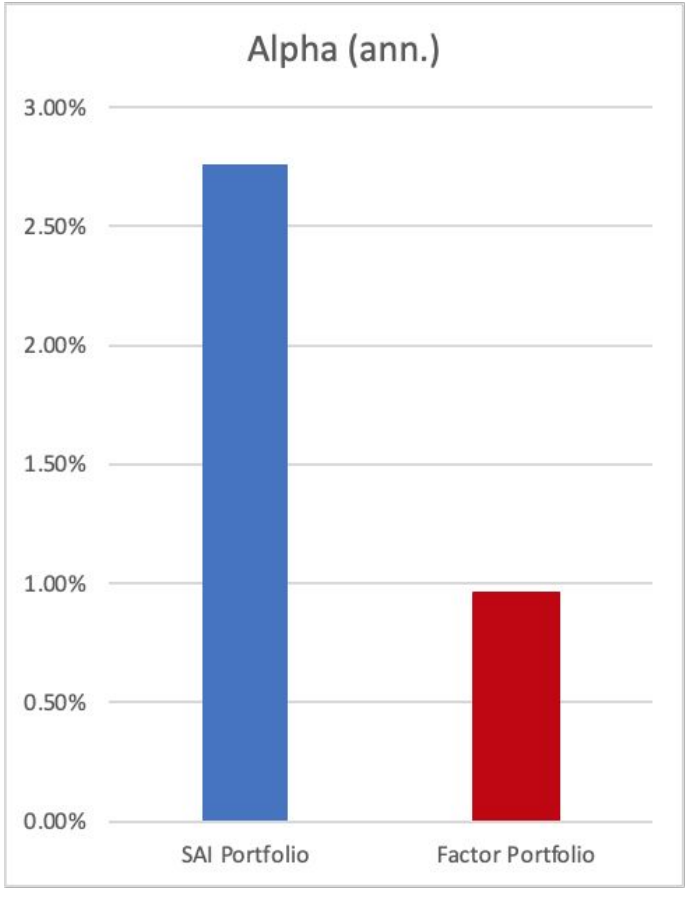
- In the tests using the 10 input series, the top three best-performing rule sets are as follows:

$$A_1 : ROA = 1 \wedge SGI = 3 \wedge TAT = 2 \rightarrow \text{High expected return}$$

$$A_2 : ROA = 1 \wedge SGI = 2 \wedge FCFTA = 2 \rightarrow \text{High expected return}$$

$$A_3 : ROA = 2 \wedge SGI = 2 \wedge FCFTA = 2 \wedge WML = 2 \wedge HML = 3 \rightarrow \text{High expected return}$$

Different investable style tilts



- The style tilts of the two portfolios are quite different.
- The returns from the SAI portfolio cannot be easily explained away.
- The SAI approach to have significantly stronger performance with a positive and statistically significant alpha.

Conclusion

- Outperforms in return and generates significantly higher alpha
- Model interpretability
- Exploits complex data more effectively
- Cannot be replicated using style factor indexes.

Interpretable AI is the here and now!

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