



THEME: CAPITAL MARKETS

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Machine Learning Improves Return Forecasting

Award-winning research from CFA Toronto shows how machine learning can improve...

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A finance professor from Canada and a data science student from France took the top prize at the 2025 Hillsdale Investment Management – CFA Society Toronto Research Award.

The work of Najah Attig, professor of finance and chair of the Department of Finance at Dalhousie University, and Chahine Attig, a data science engineering student at École Nationale de la Statistique et de l'Analyse de l'Information (ENSAI), France, provides one of the first comprehensive academic evaluations of machine learning techniques for forecasting equity risk premiums in Canadian capital markets. Compared with US, European, and Chinese markets, Canada has seen limited application of these techniques despite its distinct structural, liquidity, and informational characteristics.

"This [winning paper](#) shows promise in applying machine learning methods to extract higher-dimensional signals from the Canadian stock market," said Chris Guthrie, CEO of Hillsdale Investment Management.

Canadian markets are dominated by small-cap and value stocks with greater information asymmetry, market frictions, and liquidity constraints, creating unique challenges and opportunities for predicting returns. These characteristics highlight the need for advanced modeling approaches beyond traditional linear methods.

The researchers address two key questions:

- Can machine learning models improve Canadian stock return forecasts compared with classical linear benchmarks?
- Do patterns in anonymous trading—where traders' identities are concealed to prevent information leakage or market speculation—and variations in brokers' anonymous trading activity help predict stock returns?

Findings of the Study

- **Moderately flexible, non-linear models outperform alternatives.** XGBoost¹ and mid-depth neural networks outperform deeper neural networks and traditional linear models in forecasting Canadian stock returns.
- **Machine learning forecasts produce stronger investment performance.** Monthly long-short portfolios based on machine learning forecasts generate average excess returns exceeding 1%, with Sharpe ratios above 0.75—more than double the linear benchmark's Sharpe ratio (approximately 0.30). Annualized returns exceed 20%, with Sharpe ratios approaching 0.9.
- **Predictability is strongest among small-cap and value stocks.** These stocks dominate the Canadian equity market and exhibit frictions such as low liquidity and informational inefficiencies. Machine learning models effectively capture persistent alpha opportunities in these segments.
- **Anonymous trading signals improve forecasting.** Stocks with elevated net anonymous buying and greater broker-level order flow dispersion show stronger return predictability. Including these variables improves monthly portfolio returns by 60 to 80 basis points, with Sharpe ratios near or above 0.9 when combined with flexible machine learning models.
- **Market microstructure matters.** Liquidity, bid-ask spreads (an informational asymmetry proxy), and trading volume influence forecast accuracy. Small-cap stocks benefit most from non-linear machine learning models, while large-cap returns are driven more by systemic risk and capital structure.
- **Different market segments require different models.** Penalized linear models perform well in liquid, large-cap universes by providing stable,

interpretable forecasts, while illiquid and less efficient market segments benefit from non-linear methods such as gradient boosting and neural networks.

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Implications for Practitioners

The study suggests that machine learning can improve return forecasting by identifying complex, non-linear relationships that traditional models often miss, particularly among Canadian small-cap and value stocks where lower liquidity, greater information asymmetry, and market frictions make returns more difficult to predict.

For practitioners, the findings demonstrate that no single forecasting model is optimal across all market segments. Regularized linear models perform well for liquid, large-cap stocks, while more flexible machine learning techniques add value in smaller, less efficient market segments where return drivers are more complex.

The researchers emphasize out-of-sample performance and economic relevance through portfolio backtests, aligning their work with industry standards for robust, implementable forecasting solutions.

Their findings support a segmented approach to model development:

● Simple regularized linear models are effective for liquid, large-cap stocks.

● Opt-Out Signal Honored

- More sophisticated machine learning models are better suited to small-cap, value, and less efficient market segments.

The study also highlights the growing importance of alternative data sources. Incorporating market microstructure data—particularly anonymous order flow metrics—demonstrates how non-traditional inputs can improve investment forecasting. As financial markets become increasingly complex and data-rich, these data sources are likely to play a growing role in adaptive, evidence-based investment decision-making.

The Future of Machine Learning in Investing

More broadly, the research contributes to ongoing discussions about applying machine learning to emerging questions in finance, including:

- Climate risk pricing
- ESG-related mispricing
- Retail investor sentiment
- Algorithmic trading and return dynamics

The authors argue that future research should focus not only on improving predictive accuracy but also on interpreting machine learning-generated signals and linking them to underlying economic mechanisms. Doing so will help bridge the gap between data-driven inference and theory-consistent modeling.

As financial markets become increasingly complex and data-rich, non-traditional data sources are expected to become central to adaptive, evidence-based investment decision-making.

About the Award

The Hillsdale Investment Management – CFA Society Toronto Investment Research Award is open to researchers worldwide whose work relates to Canadian capital markets, including academics and practitioners. The winning author(s) receive a C\$15,000 prize. Research papers are evaluated by a panel of

CFA charterholder investment professionals to ensure they reflect the rigorous standards associated with the CFA designation.

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Footnote(s)

1. **XGBoost** is an open-source machine learning library based on the gradient boosting algorithm that excels at classification, regression, and ranking tasks. *(Definition provided by AI Overviews.)*

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