Objective & Data

Motivation: high-value payment systems (HVPSs) are core to national financial infrastructure.

Problem: due to the substantial volume of HVPS transactions settled each day and the scarcity of anomalous payments to date, detecting anomalies resembles an attempt to find a needle in a haystack.

Solution: we use centralized & layered framework for anomaly detection using data-driven and nonlinear machine learning (ML) tools.

Payments data: transaction-level data from Canada’s HVPS: we use clean data for training and a mix of clean & special days data for testing:
- Basic transaction features
- Liquidity features
- Intraday timing features
- Timestamp features

Methodology

Layered approach: a system-level centralized and two-layer approach to simplify pattern recognition and anomaly detection in HVPS.

Layer 1 - classification: supervised ML algorithm to classify payments based on their submission time.

Layer 2 - Anomaly detection: we use only misclassified payments in an unsupervised ML-based isolation forest (IF) model to identify and sort suspicious payments based on anomaly scores.

Results

Key results:
- Basic transaction & intraday timing features play crucial role for both classification and anomaly detection.
- Models are relaying upon multilateral and bilateral payment coordination to learn patterns and detect anomalies.
- ML models from both layers can be interpreted to understand predictions.

Actual transaction

Artificially manipulated transaction

Takeaways: Our centralized & layered framework, supported by advanced ML tools, offers a systematic approach for real-time transactions monitoring in HVPS.

*Note: The opinions here are of the authors and do not necessarily reflect the ones of the Bank of Canada or the Bank for International settlements.