Mres Research Project Proposal

Cross-predictability in FX Markets. A Principal Portfolio Approach.

Amin Izadyar

Imperial College London

Research Topic: Cross-predictability in FX Markets

- **Research Area**: Investigating cross-predictability in foreign exchange (FX) markets using the Principal Portfolio approach.
- **Framework**: Applying a novel asset pricing model that incorporates cross-predictive signals between currencies, unlike traditional models that focus solely on own-asset signals.
- **Potential Supervisor**: Pasquale Della Corte

Principal Portfolio Approach

- **Prediction Matrix**: - The matrix captures both own-signal predictability (diagonal elements) and cross-predictability (off-diagonal elements) among assets.
- **Principal Portfolios (PPs)**: - Optimal portfolios are derived from the eigenvectors of the prediction matrix, allowing for the best use of cross-asset signals.
- **Decomposition**: - Symmetric part: Corresponds to ”beta” strategies (Principal Exposure Portfolios, PEPs). - Antisymmetric part: Corresponds to ”alpha” strategies (Principal Alpha Portfolios, PAPs).

Motivation for FX Market Application

- **Interconnectedness of Global Trade**: - Cross-predictability may be more pronounced in FX markets due to the high level of economic interdependence between countries.
- **Smaller Universe of Currencies**: - A more limited number of currencies increases the likelihood of strong cross-predictive relationships.
- **Examples**: - Commodity-linked currencies (e.g., AUD, CAD) may influence each other. - The US dollar's dominant role suggests its signals may be particularly influential for other currencies.

Overview of Principal Portfolios

- **Goal of Principal Portfolio Analysis (PPA):** PPA maximizes expected return of a linear strategy while considering both own-asset predictions and cross-predictive signals from other assets.
- **Linear Strategy Definition:**

$$R_w(t+1) = w_t' R(t+1)$$

  where w_t' are portfolio weights based on asset signals, and $R(t+1)$ is the vector of asset returns.
- **Position Matrix:** Portfolio weights depend on the asset signals: $w_t' = S_t' L$, where L is the position matrix.

Key Equation for Principal Portfolios

- **Simplifying the Strategy:**

$$R_w(t+1) = S_t' L R(t+1)$$

- **Own-Signal Predictions:** If $L = I$, the strategy becomes a simple factor portfolio:

$$F(t+1) = S_t' R(t+1)$$

- **Long-Short Portfolio:** Restricting S_t to the largest and smallest signals gives:

$$LS(t+1) = D_t' R(t+1)$$

Where:

$$D_{j,t} = \begin{cases} +1, & \text{if } S_{j,t} = \max\{S_{1,t}, S_{2,t}, \ldots, S_{N,t}\} \\ -1, & \text{if } S_{j,t} = \min\{S_{1,t}, S_{2,t}, \ldots, S_{N,t}\} \\ 0, & \text{if else} \end{cases}$$

Singular Value Decomposition (SVD) of the Prediction Matrix

- **Cross-Predictive Signals:** Principal Portfolios consider not only own-asset signals but also cross-prediction.
- **Prediction Matrix:**

$$\Pi = \mathbb{E}_t[R(t+1)S_t']$$

- **Singular Value Decomposition:**

$$\Pi = U\Lambda V'$$

where U and V are orthonormal matrices and Λ is a diagonal matrix of singular values representing the strength of each portfolio.

PPA Optimization Problem

- **Optimization Objective:** Maximize expected return subject to a size constraint:

$$\max_{L:||L||\leq 1} \mathbb{E}_t[S_t' L R(t+1)]$$

- The constraint represents a bound on the portfolio size $||L'S_t||$ corresponding to portfolio weights $S_t'L$ that admits only linear strategies with a position size not exceeding the position size of the simple factor.
- **Optimal Solution:**

$$L = (U\Lambda V')^{-1/2}\Lambda U'$$

This leads to a collection of linear strategies, i.e., the Principal Portfolios (PPs).

Principal Portfolio Formula

- **Principal Portfolio (PP):**

$$PP_k(t+1) = S_t' v_k u_k' R(t+1)$$

  where v_k and u_k are columns of the SVD matrices V and U.

- **Expected Return:**

$$\mathbb{E}[PP_k(t+1)] = \lambda_k$$

  where λ_k is the k-th singular value, corresponding to the expected return of the k-th Principal Portfolio.

Portfolio Decomposition

- **Symmetric and Antisymmetric Components:**

$$\Pi = \Pi_s + \Pi_a$$

where Π_s represents the symmetric part (factor exposures) and Π_a represents the antisymmetric part (alpha-generating strategies).

- **Principal Exposure Portfolios (PEPs):**

$$PEP_k(t+1) = S_t' w_k (w_k' R(t+1))$$

- **Principal Alpha Portfolios (PAPs):**

$$PAP_k(t+1) = S_t' x_k (y_k' R(t+1)) - S_t' y_k (x_k' R(t+1))$$

Summary of Principal Portfolios

- Principal Portfolios (PPs) represent linear strategies that exploit cross-predictability and are ordered by expected return.
- Decomposition: PPs are decomposed into Principal Exposure Portfolios (PEPs) and Principal Alpha Portfolios (PAPs).
- PPA improves portfolio performance by incorporating cross-predictive signals, enhancing returns beyond traditional long-short strategies.

Extensions for PhD Project

- **Identifying Sources of Cross-Predictability**: - Investigate which currencies' signals exhibit the strongest predictive power and which are most affected. - Explore patterns in cross-predictive signals based on geographic, cultural, or economic linkages.
- **Exploring Multiple Signals**: - Extend the Principal Portfolio approach to accommodate multiple signals simultaneously, allowing for a richer model of cross-predictability.
- **Addressing Estimation Error**: - Explore the impact of estimation errors in the prediction matrix on portfolio performance through simulations.

Thank you for your attention.
Questions?