From Static to Adaptive: ECM-Based Pairs Trading under Structural Change

Celeste Falchi[1] and Paolo Zeppini[1,2]

[1]GREDEG, CNRS, Université Côte d'Azur, Nice, France

[2]Department of Economics, University of Bath, Bath, UK

celeste.falchi@etu.univ-cotedazur.fr • paolo.zeppini@univ-cotedazur.fr

1 Abstract

Financial markets are commonly described as adaptive systems, yet in empirical asset pricing and trading adaptation is typically treated as a technical convenience rather than as an economic object of interest. In cointegration-based pairs trading, long-run relations are either assumed to be stable or updated mechanically through rolling estimation, offering limited economic insight into when and how equilibrium relations themselves evolve. This project starts from a simple premise: if markets adapt, adaptation should be modeled explicitly and in economically interpretable terms.

The project studies adaptation within an error-correction framework by comparing three alternative specifications applied to the same economic structure: a static ECM, a rolling-window ECM, and an adaptive ECM in which key parameters evolve in a state-dependent manner. Cointegration and equilibrium correction are preserved throughout. Adaptation is introduced only through a constrained learning rule that regulates the intensity with which new information is incorporated into the model. Machine learning therefore plays a strictly auxiliary role, governing when adaptation occurs rather than replacing the underlying econometric structure or the economic interpretation of trading signals.

Using liquid European assets across different market regimes, the analysis evaluates performance jointly with economic coherence, focusing on the stability of inter-asset relations, the persistence of mean reversion, and the behavior of the model around periods of stress and structural change. By holding signal construction and execution fixed across specifications, differences in outcomes can be directly attributed to alternative forms of adaptation rather than to changes in trading design.

The contribution of the project is twofold. Methodologically, the project proposes an intermediate approach between static calibration and fully parametric time-varying models, in which adaptation is endogenous, selective, and interpretable rather than imposed mechanically. Empirically, it shows that making adaptation observable changes what can be learned from relative-value strategies, allowing deviations from equilibrium to be interpreted as indicators of structural change and emerging market fragmentation, with direct implications for the analysis of market stability and systemic stress.