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Estimation of the lead-lag parameter from non-synchronous data

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We propose a simple continuous time model for modeling the lead-lag effect between two financial assets. A two-dimensional process (X_t,Y_t) reproduces a lead-lag effect if, for some time shift $\vartheta\in \mathbb{R}$, the process $(X_t,Y_{t+\vartheta})$ is a semi-martingale with respect to a certain filtration. The value of the time shift ϑ is the lead-lag parameter. Depending on the underlying filtration, the standard no-arbitrage case is obtained for $\vartheta=0$. We study the problem of estimating the unknown parameter $\vartheta\in \mathbb{R}$, given randomly sampled non-synchronous data from (X_t) and (Y_t). By applying a certain contrast optimization based on a modified version of the Hayashi-Yoshida covariation estimator, we obtain a consistent estimator of the lead-lag parameter, together with an explicit rate of convergence governed by the sparsity of the sampling design.

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