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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 $\sqrt{\pi t}$ (X_t, Y_t) (the process $(X_t, Y_t+\sqrt{t})$) is a semi-martingale with respect to a certain filtration. The value of the time shift $\sqrt{\pi t}$ (the lead-lag parameter. Depending on the underlying filtration, the standard no-arbitrage case is obtained for $\sqrt{\pi t}$. We study the problem of estimating the unknown parameter $\sqrt{\pi t}$ 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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