

# CORRELATIONS AND VOLATILITIES OF ASYNCHRONOUS DATA

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*Asset prices are typically measured when markets close, although closing times may differ across markets. As a result, returns appear to have predictability, and correlations are understated. This will distort the value of portfolios, value at risk measures, and hedge strategies.*

*A solution is to "synchronize" prices by computing*

*estimates of the values of assets even when markets are closed, given information from markets that are open. From these prices, synchronized returns are defined and can be used to perform standard calculations including measuring time-varying volatilities and correlations with GARCH. The method is applied to G-7 index data.*

**D**aily data are always measured from one time to the same time twenty-four hours later. The time of measurement often differs in markets that do not have the same trading hours. In some cases, such as the U.S. and Japan, there are no common open hours, while in others there is partial overlap.

For example, the FTSE closes at 5:00 pm in London, but this is only 12:00 noon in New York. Thus any news that occurs in New York during the afternoon will not show up in British prices until the next morning, when it will be measured as part of the next day's returns.

Even if prices are quoted at only slightly differ-

ent times, there are still biases; these have been emphasized in studies of individual markets where closing prices may be stale. See, for example, Scholes and Williams [1977] and Lo and MacKinlay [1990]. When times differ by many hours, the effects can be dramatic.

In today's global markets, these problems take on a new importance. Asynchronous data complicate or bias many of the tasks of financial management. Perhaps most important, the value of the portfolio is never known at a particular time, and consequently measures such as value or value at risk may be misleading. Profit and loss for a company or for a trading desk can be seriously biased or even manipulated by the use of stale prices.