[Real and Spurious Long-Memory Properties of Stock-Market Data]: Comment

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The first summand is $K_1^2(N_b - j)I(j \leq N_b)$, the third is 0, the fourth is $K_2^2(N - N_b - j)I(j \leq N - N_b)$, and the second is

$$\begin{cases} jK_1K_2 & \text{if } 1 \leq j \leq N_b \\ N_bK_1K_2 & \text{if } N_b \leq j \leq N - N_b \\ (N-j)K_1K_2 & \text{if } N - N_b \leq j \end{cases}$$

so that the last term in (A.2) has a different value depending on j. For $1 \leq j \leq N_b$, it is

$$\Psi\theta(1-\theta) - \frac{j}{N}\,\Psi(1-\theta+\theta^2),$$

for $N_b < j \leq N - N_b$ it is

$$-\frac{j}{N}\,\Psi\theta^2,$$

and for $N - N_b < j \leq N - 1$ it is

$$-\Psi\theta(1-\theta)\left(1 - \frac{j}{N}\right),$$

with $\Psi = (\sigma_2^2 - \sigma_1^2)$ and $\theta = N_b/N$. Now the first term in (A.2) is $o_p(1)$, applying a WLLN to the uniformly integrable zero mean independent sequence $(z_t - \sigma_t^2)(z_{t+j} - \sigma_{t+j}^2)$, and the second and third terms are $o_p(1)$ using (A.1) and (A.3).

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Comment

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This article throws further light on one of the more interesting puzzles concerning speculative markets—why do measures of volatility appear to have the long-memory property? I find it easiest to think about this result in the representation $r_t = (\text{sign } r_t)|r_t|$, where r_t takes the value of 1 if $r_t > 0$ and -1 if $r_t < 0$. Suppose that sign r_t and $|r_t|$ are independent and that sign r_t is short-memory, as shown by Granger and Ding (1995); then r_t will be short-memory even though $|r_t|$ and thus r_t^2 is long-memory, as found here and in several other works. An aspect of the article that I

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find disappointing is the attention given to r_t^2 although the evidence of long memory is much stronger for $|r_t|$. Most of my own work has considered both measures of volatility, but I think that it is clear that $|r_t|$ has the more interesting statistical properties. The fractionally integrated process $I(d)$ is an example of a long-memory process, where $d = H - 1/2$ in the notation of the article, as discussed by Granger and Ding (1996) in an article that appeared in a special issue of the *Journal of Econometrics* edited by R. T. Bailey and M. L. King dealing with long-memory processes. $|r_t|$ has been found to have the properties of an $I(d)$ process with d values around .45 using speculative prices from various stock markets and also commodity prices. It is surprising that the article being discussed does not report the estimated value of H that must arise when performing the Lagrange multiplier tests because these values could be compared to values found by other procedures.

It will not be considered surprising that r_t is short-memory because some forms of the efficient-market theory would not expect any predictability. The long-memory finding for volatility does not go against any major financial theory and does need an explanation. The authors do consider several possibilities.

1. *Seasonality*: Although returns may contain some small evidence of seasonality, the amounts found in volatility in measures such as autocorrelations would be insufficient to explain the observed long-memory property.
2. *Aggregation*: Most of the aggregation results available are for independent AR(1) series aggregating up to an $I(d)$ process. It is clear, however, that groups of series in finance are highly unlikely to be independent because investors will share publicly available information. When considering a stock index, the capital asset pricing market (CAPM) theory suggests that the components are very interrelated, with individual returns having the market return as a common component, so that $r_{jt} = \alpha_j + \beta_j M_t + \varepsilon_{jt}$, where M_t is the market return. In some unpublished work of my own, with Z. Ding, we considered returns for 10 shares in the Dow Jones Index, finding that each had absolute returns that were long-memory, as was M_t, but we also found that, if the CAPM was estimated, the terms $|\varepsilon_{jt}|$ also appeared to be long-memory.
3. *Regime Switching*: Although it does seem likely that a stationary process that encounters occasional regime changes will have some properties that are similar to those of a long-memory process, it is unclear how one actually gets a specific process, such as $I(d)$ with fractional d. Granger and Ding (1995) took the daily S&P absolute returns, with a sample size of about 17,000, and divided the sample into 10 equal-sized subsamples. If an $I(d)$ process is fitted for each, the estimated d's do vary, between about .15 and .7, suggesting that there is both nonstationarity and long memory.

I find this a particularly interesting area, which is throwing up a series of facts that are in need of an explanation. I welcome this contribution to the literature in the area. It provides a new test and some new empirical results but still leaves the reasons underlying the results unexplained. I feel that when a satisfactory theory for this area is found it will unlock a rush of new results having real practical importance.

ADDITIONAL REFERENCES

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Comment

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Whether or not volatility in financial asset returns displays long-memory properties is a question of substantial current interest. In this contribution, hereafter L–S, the authors have investigated this question using a test for the absence of long-memory components reflecting a line of work by Robinson and others. The test used in the article is grounded in the work of Lobato and Robinson (1997), hereafter L–R, which provides an asymptotic justification for the test and evidence on its finite-sample performance. In t hese comments, I will address the question of whether this test is a reliable tool for applied econometricians. There is theory and evidence from L–R that is important in answering this question, and I will supplement that with a little evidence of my own.

A natural starting point is the question that confronts every investigator using nonparametric tests of this kind: Given the dataset in hand, what is a good choice for the bandwidth parameter m? This question is critical in the case of the test used in the article. Consider the evidence in Table 1, which is taken from Monte Carlo results reported by

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