A COMMENT: "SHORT-RUN INTEREST RATE CYCLES IN THE U.S.: 1954-1967"

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In a paper published in an earlier issue of this journal, Melnik and Kraus [3] reported the results of their time-series analysis of the yields on U.S. government securities. The data used by the authors are somewhat unique in that the observations were derived from a regression-fitted yield curve, and in that the trend in mean was removed by employing deviations from a fitted trend line as the time series to be analyzed. The authors applied cross-spectral methods to their derived monthly time series for ninety-day Treasury bills and ten-year Treasury bonds, encompassing the years 1954-1967. Their interpretation of the results of their analysis led the authors to conclude that a cycle of eighteen to twenty-four months is significant and that the ten-year rate leads the short rate, thus apparently lending credence to the expectations hypothesis of the term structure of interest rates. A close examination of the basis for the Melnik and Kraus conclusions leads one to believe that they are questionable on the following two counts.

First, the conclusions are a result of the authors' interpretation of the coherences between the two time series at various frequency components. The authors feel that because the coherences are highest at these two frequencies, for the two lag windows which they used, a cycle is indicated. However, the coherence between two time series at a given frequency component is simply a measure of the degree to which the two time series are related at that frequency. The presence of high coherence at a given frequency does not, by itself, indicate that a cycle of the length corresponding to that frequency is present in either time series. The coherence between two time series, X_t and Y_t, at frequency w is given by:

$$C(w) = \frac{c^2(w) + q^2(w)}{f_X(w)\, f_Y(w)}$$

where $c^2(w)$ is the value of the cospectrum, $q^2(w)$ is the value of the quadrature spectrum, and $f_X(w)$ and $f_Y(w)$ are the values of the power spectra of series X_t and Y_t, all at frequency w. Now, clearly when the amplitude of the cross-spectrum $[c^2(w) + q^2(w)]$ and the values of the power spectra are all "low" at a given frequency, the coherence will in fact be "high." However, the fact that

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the power spectra values are low indicates that no cycle of a length corresponding to that frequency exists in either time series. As suggested by Bonomo and Schotta [1, p. 58], the logical way to look for common cycles in two time series is to first locate frequencies where the spectra of both series contain considerable power and only then to consider the cross-spectral statistics. If in fact no significant cycles exist in the data, then no further analysis in terms of phase angles, which is important in the Melnik and Kraus article, is justified.[1]

The second objection to the authors' conclusions involves their use of the phrase, "significant cycles." Statistical significance testing in spectral analysis is a very inexact area, apparently with very little theoretical justification. Therefore, to loosely use the word "significant" in this sense without using even crude, generally accepted significance testing is very misleading. The primary contribution of the Melnik and Kraus paper should be its implications for the term structure of interest rates, and the implications drawn by the authors are only valid if in fact a cycle does exist.[2]

Thus it appears that on the basis of the analysis presented to the reader in the Melnik and Kraus study, the conclusions drawn are stronger than the evidence justifies. As an alternative to their study, I present a portion of a more comprehensive study of security yields in which I applied spectral and cross-spectral methods to weekly first differences of data on the ninety-day Treasury bill yields and long-term government bond yields from 1952-1967, printed in the statistical section of the *Federal Reserve Bulletin*. First differences have been used in numerous spectral studies, as pointed out by Melnik and Kraus, and in addition to serving a trend removal purpose, they provide data on changes in yields which are theoretically preferable to levels of yields. The Melnik and Kraus trend removal method is open to question in that it involves the implicit assumption of a single trend over time, which an examination of a graph of the data over the relevant time period does not justify. The Melnik and Kraus method also implicitly denies that the data is part of a cycle somewhat longer than the length of the sample time series.

Using the BMDO2T program in the U.C.L.A. Biomed Series on a CDC 6400 computer with 130 as the maximum number of lags, I analyzed my data and employed the rough

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[1] For further discussion of the difficulties in interpreting coherence see [2], page 108.

[2] For further discussion of significance testing see [2], page 62, and [4], page 343.

confidence intervals suggested by Granger and Hatanaka [2]. I found peaks outside the 90 percent confidence limits corresponding to cycles of length twenty *weeks* and sixteen *weeks* for government bonds but no peaks outside the confidence limits for Treasury bills, although a peak clearly higher than any other occurred for a cycle of length four to five *weeks*. Table 1 summarizes the cross-spectral results at those frequencies at which both time series had peaks in their power spectra, even though they did not correspond to significant common cycles.

TABLE 1

First Differences: Government Bonds and Treasury Bills

Common Peak	Cycle Length	Coherence	Phase*
.008 cycles/week	125 weeks	.7757499	-.0359172
.019 cycles/week	50 weeks	.7034516	-.1014032
.231 cycles/week	4-5 weeks	.2020299	+.3023675
.412 cycles/week	2-3 weeks	.7514134	+.0388316
.500 cycles/week	2 weeks	.8750765	-.0242804

*Negative phase indicates lead by government bonds.

The coherences in Table 1 are generally high (except the frequency .231 cycles/week) but the peaks they correspond to are in general quite small (except the frequency .231 cycles/week in Treasury bills). These results tend to refute the claims of Melnik and Kraus that a significant cycle of eighteen to twenty-four months exists for both government bonds and Treasury bills and leave their analysis of lead-lag relationships open to question.

REFERENCES

[1] Bonomo, Vittorio, and Charles Schotta. "A Spectral Analysis of Post-Accord Federal Open Market Operations." *American Economic Review*, March 1969, pp. 50-61.

[2] Granger, C.W.J., and M. Hatanaka. *Spectral Analysis of Economic Time Series*. Princeton, N. J.: Princeton University Press, 1964.

[3] Melnik, Arie, and Alan Kraus. "Short-Run Interest Rate Cycles in the U.S.: 1954-1967." *Journal of Financial and Quantitative Analysis*, September 1969, pp. 291-299.

[4] Naylor, Thomas H., Kenneth Wertz, and Thomas Wonnacott. "Spectral Analysis of Data Generated by Simulation Experiments with Econometric Models." *Econometrica*, April 1969, pp. 332-352.