C. W. J. GRANGER (in association with M. HATANAKA). *Spectral Analysis of Economic Time Series*, Princeton University Press, 1964. $8.50. xviii + 300 pp.

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The book has a misleading title, since its scope is *nonparametric* spectral analysis. In the area of time series analysis so defined the book has broad coverage, giving a many-faceted exposition of modern spectral techniques, with rich graphic illustrations, and with comments oriented toward "empiricism without theory" rather than toward the testing of fullfledged hypothetical models. Spectral analysis for purposes of parametric model building is toned down or suppressed. Since parametric vs. nonparametric approaches are competitive rather than complementary, the restriction of the scope of the book is a severe one, and if it were to upset the existing balance of the two lines of approach it would set back the clock of econometrics by some 35 years.

The following comments serve to substantiate the above brief appraisal. But first of all the list of contents:

Chapter headings: 1. Introduction to the analysis of time series; 2. Nature of economic time series: Part A. *Stationary time series*; 3. Spectral theory; 4. Spectral analysis of economic data; 5. Cross-spectral analysis; 6. Cross-spectral analysis of economic data; 7. Processes involving feedback: Part B. *Nonstationary time series*; 8. Series with trending means; 9. Series with spectrum changing with time; 10. Demodulation; 11. Non-stationarity and economic series; 12. Application of cross-spectral analysis and complex demodulation: Business cycle indicators (by M. Hatanaka); 13. Application of partial cross-spectral analysis: Tests of acceleration principle for inventory cycle (by M. Hatanaka); 14. Problems remaining; Index.

1. Speaking broadly, spectral analysis comes to the fore when the observed time series are long, relative to the periods or waves under consideration. This is so, for example, in the study of ocean waves, where under specified wind conditions the number of waves runs into hundreds and thousands. Similarly in the filtering of radio signals, radar detection problems, and so on.

With a large number of periods, waves, it is often illuminating and more convenient to work in the *frequency domain* of the spectrum than in the *time domain* of the observed data (the frequency is inversely proportional to the length of a period). But with a small number of periods it is more or less artificial to emphasize the frequency domain, especially if the periods are irregular in length and/or amplitude, as is the case in economic applications.

The requisite of a relatively large number of periods, waves, to be covered by the data for spectral analysis to be fruitful is not adequately emphasized by the authors. Econometricians, both advanced and less advanced ones, must ask what is gained by a spectrum where it is only all too clear that many features are the