CHAPTER I
THE LINEAR DYNAMIC ECONOMETRIC MODEL

1. INTRODUCTION

Previous work on this topic goes back to Wicksell (1907)\(^1\) who takes into consideration uncorrelated random numbers in order to explain business cycle motions. Later, Yule (1927) and Slutsky (1937) apply an autoregressive and a moving average scheme, respectively. They show that these series have many of the apparent cyclic properties which characterize economic time series.

Frisch (1933) links economic theory - represented by linear dynamic deterministic models - with the stochastic approach of business cycle analysis. In general, the deterministic solutions of linear dynamic econometric models produce damped oscillations, though business cycles observed in reality are not damped. Frisch shows that a consideration of residuals may resolve this discrepancy.

Haavelmo (1940) applies a stable second order autoregressive process with real roots and points out that taking into account uncorrelated random numbers leads to an oscillating solution. Later on, Fisher (1952) and Kalecki (1956), who use simple examples, demonstrate that in a stable system an error process consisting of a realisation of independent random variables produces cycles with almost constant amplitudes.

Adelman and Adelman (1959) investigate the cyclic behavior of a larger estimated econometric model - the Klein-Goldberger model - through stochastic simulation experiments, specifying turning points by the NBER-method. They conclude that the Frisch hypothesis of the explanation of business cycles cannot be rejected. The same result is given by Arzac (1967) for the Chow model (1967) who pursues the same methodological approach. However, a systematic analysis of stochastic properties of four large models of the U.S. economy by simulations appeared for the first time in Hickman (1972). Fitzgerald (1973) and Sowey (1973) also use simulation methods to treat the dynamic properties of two econometric models of Australia. Finally, some results of stochastic simulations of the "Wiesbaden"-version of the Krelle model for the FRG are presented in Krupp (1972).

For investigating the Frisch hypothesis for linear or linearized models one has in addition the possibility of using analytic methods developed by Chow (1968, 1975) and Howrey (1971). These approaches are based on Fourier methods and assume fixed exogenous variables and un-

\(^{1}\) Quoted from Frisch (1933, p. 198).

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correlated residuals. They have been applied in a few cases to estimated models, such as those of the U.S. economy by Chow and Levitan (1969a), and by Howrey for the Klein-Goldberger model (1971) and the Wharton model (1972). With the same method, Deistler and Schleicher (1972) study the effects of the disturbance processes for an econometric model of Austria as well as Wolters (1976) for alternative estimates of the van der Werf-Beckmann-Uebe model and Laven (1977) for an aggregated model of the FRG.

As has been shown by Howrey and Kelejian (1971), neglecting residuals implies serious biases for the forecasts and multipliers in the case of nonlinear models. A general theory for an analytical treatment of stochastic properties in nonlinear models has not yet been developed. There are only some approaches, though e.g. those of Bowden (1972) and Howrey and Klein (1972).

Adequate modelling of the exogenous variables and the residuals is very important with respect to the forecasting properties (Menges (1977)), to the effectiveness of policy measures (Goldfeld and Blinder (1972)), and finally to the business cycle movements. Hence, we extend the spectral analytical approach in order to evaluate the influence of general linear stationary residual processes and the influence of the stochastic parts of the exogenous variables on the dynamic properties of linear econometric models. Some applications of this approach which regard both business cycle oscillations and the properties of stabilization policies are presented in Wolters (1978b, 1980).

With the exception of Krupp (1972), all the papers mentioned above assume that estimated regression coefficients are fixed parameters. This is quite in the line of the theoretical specification of classical econometric models. In this study and in Wolters (1978a), an approach is suggested which explicitly takes into consideration the stochastic nature of the estimated regression coefficients in order to test the Frisch hypothesis.

We want to emphasize that the main purpose of this study is to develop and apply additional diagnostic checks of the stochastic dynamic properties of structural econometric models since, in general, many studies which analyze and use econometric models neglect the stochastic elements. A synthesis of traditional econometric models and modern time series analysis - as has been stressed by Zellner (1979), Zellner and Palm (1974) and Wallis (1977) - is also performed in this study.