MACROECONOMIC MODELS AND ECONOMETRICS

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1. INTRODUCTION

In his paper on Macroeconomic models and econometrics Professor Kloek surveys contributions of econometrics to macroeconomic model building. In the introduction he states: 'our main problem is: how can we improve the existing models or construct entirely new types of better models'. The paper focuses on the first part of the problem as it is concerned with a discussion of issues in econometrics and ways to improve macroeconomic models.

I would like to congratulate Professor T. Kloek for having succeeded in reviewing the vast literature on econometric model building and for having presented the basics in a very lucid and thoughtful way. There is a lot to agree with in the paper. Given the large number of topics in econometrics that are relevant for macroeconomic modelling, the author had to be selective. I would like to start with a general comment and then make some remarks on the various topics discussed by Professor Kloek. I will also have to be selective. I will look at the paper from a user's point of view and try to indicate where econometrics can contribute to improve macroeconomic modelling.

In the introduction, the author compares econometric models to cars. Like cars, models differ in size, style, etc. and serve different purposes. The decision to buy a certain type or model of a car depends on the purpose for which the car is used. A person who needs a car for him or herself only will not seriously consider to buy a bus. It is here that the comparison of econometric models to cars by Kloek ends.

In the sequel the author discusses criteria to measure the quality and
performance of models without relating the choice of the criteria to the purpose for which the econometric model is used. Perhaps, it it implicitly assumed that the model has to serve multiple purposes, so that it has to satisfy several criteria. It is my impression, however, that an econometric model can hardly be the best buy when it has to be judged separately in terms of its performance in forecasting, policy analysis, hypothesis testing and structural analysis.

For instance a simple time series model may do extremely well in shortrun forecasting at very low costs although it is usually not suited at all for policy analysis. In fact, the forecast performance of a simple ARIMA-scheme may be better (even in the population) than that of a causal model. To illustrate this point, I refer to an example given by Wallis (1982) who considers a variable \( y_t \) generated by the nonlinear model \( y_t = (\beta x_t + \epsilon_t)^2 \) where \( x_t \) is strictly exogenous and generated by a first order autoregressive process and \( \epsilon_t \) is a white noise. The one step ahead mean square error (MSE) of predicting \( y_t \) by \( \hat{y}_t = \beta^2 \hat{x}_t^2 \) where \( \hat{x}_t \) is the forecast of \( x_t \) obtained from the time series model, is larger than the MSE of forecasting \( y_t \) from the implied ARMA(2,2) model for \( y_t \). Here, the problem is not to select the best model from a class of models, but to choose that form of the model which is most suited for the purpose at hand, namely forecasting.

These comments also imply that model selection criteria which Kloek discusses in section 8 should be in principle derived from a decision theoretic framework. For instance, Bayesian analysis explicitly adopts a decision-theoretic approach to model selection. It is questionable whether models designed for policy analysis should be selected by means of Akaike's information criterion which measures the forecasting performance.

To conclude, just like product tests by consumer associations distinguish between the purposes a product is used for, econometric methodology should also emphasize that a model may be more suited for some purposes than for others. This has since long been recognized by the Central Planning Bureau as it has been using different tools for short-, medium- and longrun planning and policy analysis.

Let me now comment on the topics discussed by T. Kloek.
2. STYLES OF MACROECONOMIC MODELLING

Concerning the five different styles of macroeconomic modelling discussed in section 2, it seems to me to be more important to emphasize the usefulness of the various approaches in macroeconomic model building instead of pointing out the differences. The protagonists of these modelling styles may have their own reasons for emphasizing the differences between their products rather than their complementarity.

Models like those of DRI have the advantage that they yield internally consistent conditional forecasts and responses to policy simulations for large numbers of economic variables. One of their weaknesses is that their dynamic properties are often not completely understood and that - given their size - they have not been subjected to extensive statistical testing. Hendry's approach to econometric specification testing and quality control applied in large scale macroeconomic modelling could lead to substantial improvements. Error correction models (ECMs) deserve special attention in bridging the gap between economic theory and the data in macroeconomic modelling, although the hypothesis of cointegration should always be tested before it is incorporated into a model. According to K.P. Wallis (this volume) the use of systematic dynamic specification analysis and ECMs in some macroeconomic models for the UK has lead to significant improvements. I expect this to be the case for other models as well.

Interestingly, the first ECMs were made in Holland, i.e. in earlier models of the CPB error correction mechanisms were included. Attractive features of ECMs are that they can be used to model certain types of disequilibria (tension indicators) and that they allow the long-run properties of the model to be derived from economic theory and the short-run dynamics to be determined from the data. Care should be taken when the target variable is nonstationary [see e.g. Kloek (1984)]. What is still needed is a microeconomic foundation of ECMs. Hendry did rationalize it in terms of adjustment costs. More recently, Palm and Winder (1987) derived an 'ECM' from the life cycle consumption hypothesis under uncertainty by assuming that the planning horizon of the consumer moves ahead in the future as time goes on.

Sims views his vector autoregressive (VAR) approach as an alternative to
traditional macroeconomic modelling. I prefer to view it as a complement to it in the sense that the VAR-model can be interpreted as an approximation of the autoregressive form associated with the Wold representation of the endogenous variables in a macroeconomic model. The number of the variables included in the VAR is not crucial as long as the Wold representation has approximately constant parameters so that one can obtain a VAR for any subset of variables by eliminating the other variables through marginalization or substitution. Of course the meaning of the parameters changes with the choice of the variables. VAR-models have been interpreted as (approximations to) reduced form equations in which the exogenous variables have been endogenized (as has been proposed by Professor Cramer at the Conference). They are an intermediate step in deriving Tinbergen's (1940) final equations.

The analysis of the VAR-models for various subsets of variables can be useful in a preliminary investigation of the data to check for special features such as parameter constancy, the presence of outliers, Granger-causality structures that allow to eliminate theories as being in contradiction with the information in the data. In a recent paper, Sims (1986) has shown that identifying assumptions can be incorporated in the VAR-models so that they can be used too in policy analysis.

Finally, some of the classical studies referred to by Kloek are concerned with the analysis of important equations of macroeconomic models. Studies of a consumption function and labour and capital demand functions derived from intertemporal utility or profit optimization under uncertainty taking into account changes in the environment [not only changes in policy rules, the case considered by Lucas (1976)] are expected to yield insights that can be useful for improving the dynamic specification of large scale macroeconomic models.

To summarize, to the benefit of the macroeconomic model builder, it is more important to emphasize the purposes for which different modelling styles can be used than to stress the differences as is usually done for obvious reasons by the advocates of these styles.
3. BASIC ISSUES IN ECONOMETRICS

Besides causality, multicollinearity, parameter interpretation and identification, I think that parameter stability is a basic issue in modelling. There are at least two reasons for that. First, the sampling period in macroeconomics is usually fairly long, so that it is likely that some changes have occurred in the structure of the economy. Second, in his critique, Lucas (1976) has shown what the implications are for the structure of the model of a change in the environment of an optimizing economic agent. Microeconomic models can be designed in such a way that they appropriately take into account the implications of rational agents [for an example, see Palm and Winder (1987)]. This requires that the exogenous variables are endogenized and that their process is carefully analyzed.

As long as the parameters of the econometric model and of the process generating the exogenous variables are stable, both conditional and marginal modelling are valid.

Multicollinearity can be interpreted as a form of lack of identification which can be remedied by introducing a priori information on the parameters, for instance reformulating a dynamic regression equation in levels into a specification expressed in first differences possibly with error correction terms [see e.g. Davidson et al. (1978)]. In this way it is often possible to achieve a specification in which the explanatory variables are (nearly) orthogonal (as in experimental design). The difficulties with the interpretation of the parameters in the model (3.1)-(3.2) result from the fact that \( x_{1t} \) is endogenous but treated as exogenous when equation (3.2) is ignored. Because of the recursiveness of the model, equation (3.1) can be estimated as a regression equation. Its reduced form required for policy analysis, however, corresponds to expression (3.3).

With respect to the discussion about identification in section 3, I would like to say that overidentification rather than identification is a central subject in almost any science. To explain and understand the working of the economy, we need theories or hypotheses that can be subjected to tests and that can be refuted in the light of empirical evidence. To achieve this, it is not necessary that all the parameters in the model are identified. The structural form of a simultaneous equations model is mainly instrumental in generating testable restrictions on the parameters of the model. In the words of Malinvaud (1981), imposing restrictions on the
parameters can be interpreted as shrinking the estimator not to zero but in directions that are plausible from the point of view of economic theory. To summarize, besides the issues mentioned by Kloek, achieving structural stability of the model and generating testable restrictions on the parameters are in my view basic in economic modelling.

4. ECONOMIC THEORY

Concerning the role of economic theory, in particular in the presence of aggregated data, I wonder why the author does not mention the distribution approach to economics and econometrics, which has successfully been applied to study disequilibria on the labour market [see Kooiman and Kloek (1979)] and which has since then been incorporated in the models of the Central Planning Bureau. The distribution approach offers new ways to improve macroeconomic modelling.

As already stated above, ECMs are useful to integrate both theory and features of the data into an econometric model. The aggregate nature of macroeconomic time series probably explains why the forecasting performance of univariate and multivariate time series models is often superior to that of econometric models which are based on econometric theory. For some recent examples, I refer to Litterman (1986) and the references therein and Garcia-Ferrer et al. (1987). Many economic series are stationary in the first differences. Aggregation flattens the spectrum of stationary time series and explains why many aggregate economic series can be approximately represented as a random walk. In the Bayesian procedure put forward in e.g. Litterman (1986) the coefficients of a VAR-model are centered on a random walk process for the individual series.

It seems to me that the unsolved problem of aggregation in structural econometric modelling has been turned into a strenght in the time series approach which takes account of the very nature of the series to be forecasted. Therefore, improvements of econometric models are expected from a continuing interaction between theory and empirical analysis. Theories which have not been tested or which are in contradiction with facts are unsafe to use. Models based on empirical regularities only may break down when major changes occur in the economic environment.
5. DATA PROBLEMS AND DATA TRANSFORMATIONS

I prefer to discuss data problems together with data transformations. Data transformations often result from data problems. Given that economic data are collected for other purposes than model building, they frequently measure other magnitudes than the variables appearing in the theoretical model. The occurrence of measurement errors and seasonality illustrates this phenomenon which is explicitly recognized in systems theory where the so-called measurement equations are part of the formal model. In econometrics, model-based approaches to data problems is the new technology which replaces widely used ad-hoc approaches. It should be useful in getting better insight into the dynamic interrelationships between economic variables. Examples are the unobserved component models put forward by Nerlove et al. (1979) to model seasonality, better known as structural time series models [see Harvey and Todd (1983)]. Multivariate models for variables with common stochastic trends are a natural extension of the structural time series models. By adopting a model-based approach to data problems it becomes possible to incorporate a priori information on the data problem into the model and to jointly test the complete specification of the model against the information in the data. In ad-hoc approaches to data problems, the restrictions derived from economic theory are analyzed conditionally on the transformation of the data.

Finally, in commenting on Kloek's statement in section 5 that 'it would be very useful to have monthly observations on all major macroeconomic variables', I like to note that contrary to the wide-spread belief the information gain from data collection at a disaggregate level may not be substantial in many cases [see e.g. Nijman and Palm (1987) for results on ARIMA-models]. In conclusion, data problems should not be solved in a mechanical way but in the light of theory and other subject matter considerations.

6. MODEL ESTIMATION, SELECTION, EVALUATION AND COMPARISON

Hendry put forward a unifying structure for estimation methods for lineair simultaneous equation systems (SEM) with disturbances that are white noise or autoregressive. Hendry's unifying framework was generalized by Espasa
(1977) to SEMs with stationary disturbances including autoregressive and moving average disturbances as special cases. Recently, unifying frameworks for econometric estimators for different models have been provided by Hansen's (1982) generalized moment estimation method and by the method of asymptotic least squares [see e.g. Gouriéroux et al. (1985)]. The latter method also appeared to be very useful in designing numerical procedures to compute the estimators.

As stated in the introduction, a decision theoretic approach to model selection is at least in principle desirable. In the Bayesian approach, the problem is formulated in terms of minimization of the posterior expected loss function. Through the choice of the loss function, the investigator can take into account the purpose for which the model is used. Model selection criteria which are consistent should preferably be used in applied work. Nevertheless, the investigator should be aware of the fact that in small samples, the probability of selecting a wrong model can be fairly large. Sneek (1984) has shown that for univariate ARIMA-schemes, in small samples one can at best expect to select a model that is close to the true model (in terms of a distance which is a function of the ratio of the one step ahead prediction error variances of the model considered and the true model).

In conclusion, model estimation, selection, evaluation and comparison have received much attention in the econometric literature. They have been imbedded in general approaches. Although OLS has sometimes reasonable small sample properties in situations where it is consistent, it is unsafe to advocate its use in general linear models. Moreover, the many nonlinear models in econometrics usually require nonlinear estimation procedures.

7. SOME CONCLUDING REMARKS

As stated in the introduction, I had to be selective in my comments. In choosing the points to discuss here, I adopted for myself the (subjective) criterion of potential relevance for macroeconomic modelling. Many topics were not discussed. Among them, I would like to mention the pooling of various sources of information such as from cross-sections and time series but more importantly for macroeconomics from international data.
REFERENCES


