BOOK REVIEWS


1. OVERVIEW

Since the early 1960s the London School of Economics (LSE) has been the central organ in Europe for teaching and research in econometrics. In succeeding years waves of MSc and PhD graduates have emerged annually from the LSE, armed with the technology provided by Denis Sargan's course in advanced econometric theory. These lecture notes record the content of that course, so that it is available for the first time to a wider audience. However, they do much more than this. They help to define a generation of English econometrics—by what the students in this course learnt, by what they, as teachers, later taught their own students and by the technical knowledge that LSE graduates brought to bear in their research. For this reason I believe that the present volume is as much of historical interest as it is of value for its material content. Meghnad Desai deserves our thanks for his efforts in bringing this worthwhile project to fruition and our congratulations on a job well done.

In his Preface Denis Sargan tells us that the original concept of the course was 'to allow the student to derive most of the asymptotic theory of the linear simultaneous equations model from a few clearly stated theorems of asymptotic theory'. There is little doubt that the course was enormously successful in this respect. Looking at the curriculum that it defines we see the pedagogical strengths of this simplicity of purpose. It emphasizes fundamentals—simple asymptotic tools of statistics are put to work to develop a body of knowledge that is still to many the logical core of econometrics. The emphasis is on this body of knowledge and its constituent pieces, not the statistical limit theorems that are used in their derivation. Again and again in these lectures we see the use of Slutsky's theorem and Cramér's transformation theorem in clinching the argument of the asymptotics. Or as Sargan would put it in his actual lectures: 'just use generalised Slutsky and generalised Cramér'. Asymptotic theory couldn't be much simpler than this. And the results come thick and fast in the delivery.

2. CONTENTS OF THE VOLUME

The lectures begin with a review chapter on the foundations of asymptotic theory. The material is accessible to students who have done an introductory econometrics course and know some statistical theory at the level of Mood and Graybill or Hogg and Craig. The chapter covers elementary convergence concepts (in probability, in mean square and in distribution), stochastic order relations, Cramér's transformation theorem, the continuous mapping theorem (here called the general transformation theorem), asymptotics for least-squares and maximum-likelihood in the i.i.d. error case and some indicators of how to proceed when the errors are temporally dependent. This is a broad coverage of topics for 21 pages. Most of the results needed are stated with no proof (and no references) and the presentation emphasizes the use of the results in regression situations. Several examples are given. In this chapter the vintage of the material will be evident to modern theorists. It is therefore all the more remarkable that these lectures accomplish so much in the way of applications to econometrics, getting as far in the subsequent theory as dynamic linear models with nonlinear restrictions on the coefficients. A few limitations should be mentioned: (i) Hannan's central limit theorem for sample covariances of a weakly dependent time series is incorrectly stated (the formula for the asymptotic covariance matrix $V$ on page 11 needs an expectation operator and it would have been useful to have given explicit formulae). This is
a little unfortunate because the theorem is used so extensively in the book. (ii) In discussing the autoregressive model on page 20 it is stated that standard CLT's (for i.i.d. variates) can be applied to sample covariances, such as $T^{-1/2} \sum_{i=1}^{m} \lambda_i \gamma_i$, between the errors and the lagged regressors. This is not so. The variates $\{u_t, \gamma_t, \gamma_{t-s}\}$ form a martingale difference sequence with respect to the natural filtration associated with $u_t$ and it is an example of the beauty and elegance of the martingale theory that partial sums of such sequences are handled as easily by the martingale central limit theorem (for stationary and ergodic differences) as i.i.d. $(\theta, \sigma^2)$ variates are by the Lindeberg Lévy theorem. It is a pity that even now so few econometrics courses use the martingale approach; and the textbook of econometrics that develops its asymptotics by martingale approximations is still to be written.

Chapters 2 and 3 introduce the reader to the notation of the simultaneous equations model and to issues of identification. System-wide identification criteria are given and these are specialized to the case of separable constraints. Covariance matrix restrictions are not included in the theory.

Chapters 4–7 deal in an extensive way with the estimation of simultaneous equations. The theory is asymptotic and it is a more complete treatment than that of any other textbook on the market. The approach is strongly influenced by Sargan's own research on instrumental variables estimation, as well as the early Cowles Commission research embodied in Cowles Monographs Volumes 10 and 14 edited by Koopmans (1950) and Hood and Koopmans (1953), respectively.

The discussion begins with single-equation estimation in Chapter 4. Conventional asymptotics for least-squares and generalized least-squares are given for models with strictly exogenous regressors. Some interesting exceptional cases are mentioned, such as models with heterogeneous errors and exploding variances, where the usual asymptotics break down. Instrumental variable (IV) methods are introduced in Chapter 5 in the single-equation context. Here the exposition is clear and instructive, demonstrating the versatility of IV methods and the simplicity of the asymptotic theory. The development follows Sargan's own research and those who are unfamiliar with his (1958) and (1959) articles in *Econometrica* and * JRSS(B)* will be surprised to see that the treatment includes models with nonlinearities in the coefficients and autoregressive errors. Again, the treatment shows how far you can get in studying the econometrics of simultaneous equations with simple asymptotic tools. Those familiar with the theory of nonlinear estimation will note that the conditions given for the consistency of the IV estimator of $\theta$ in the model $y = X\eta + u$ in Theorem 5 on page 55 are not sufficient. One needs to confine $\theta$ to a compact set or otherwise exclude the possibility that $a(\theta_i) \rightarrow a(\theta)$ for some sequence $\theta_i$ not tending to $\theta$, the true value of $\theta$. The same problem arises in the discussion of nonlinear least-squares in Section 1.3.2.

Chapter 6 deals with systems of simultaneous equations and develops three-stage least-squares (3SLS) as an IV procedure. A first approach follows the single-equation discussion and derives the optimal instruments for the stacked system of linear equations. A second approach gives 3SLS as an optimization estimator. The advantage of the latter is that nonlinear as well as linear constraints on the coefficients can be introduced. This not only facilitates the development of the asymptotic theory from the first-order conditions but also prepares students for the more general subject of nonlinear estimation, which is not treated here. The chapter ends with a good discussion of the comparative efficiency of systems and single-equation IV estimators under separable constraints.

Chapter 7 is an extensive treatment of maximum-likelihood estimation of simultaneous equations, covering full information (FIML) estimation (in Part A of the chapter) and limited information (LIML) methods (in Part B). The model is set up to allow for nonlinearities in the parameters, first-order conditions are derived using matrix differentials and the asymptotic covariance matrix of the FIML estimator is found by deriving the limit of the hessian. The treatment is algebraic and the statistical theory relies on that for maximum-likelihood in general. As a result, the asymptotic development is not as rigorous as that given elsewhere, for example, in Malinvaud's (1980) text. The emphasis is instead on algebraic manipulations, and this approach is particularly helpful in establishing the asymptotic equivalence of FIML and 3SLS through their respective estimating equations. Models with vector autoregressive errors are also considered and the relevant first-order conditions are derived. It would also have been useful to give the limit theory and the asymptotic covariance matrix explicitly for this commonly occurring case.

Part B of Chapter 7 deals with the LIML procedure. The algebra is developed in general for the subsystem (rather than just the single-equation) case and the concentrated likelihood function is derived, leading directly to the least generalized variance ratio interpretation of LIML. Asymptotic equivalence between subsystem LIML and 3SLS is established and the chapter concludes with short sections on reduced form estimation (where some of the respective finite sample properties of LIML and 3SLS are alluded to) and subsystems with nonlinearities in the coefficients.
Chapters 8 and 9 are concerned with statistical testing in the simultaneous equations model. They provide an interesting and useful complement to the earlier chapters on estimation. Chapter 8 deals with misspecification tests. The likelihood ratio (LR) test of the validity of overidentifying restrictions is developed first. This follows the original work of Anderson and Rubin (1949, 1950). The second test is Sargan's own asymptotic \( \chi^2 \) test for the validity of the instruments in an IV single-equation regression. This is shown to be a useful omnibus test for equation misspecification and residual autocorrelation as well as misspecification of the instruments. The derivation and discussion of this test is especially useful in view of its current popularity in empirical research, following the work of Hansen (1982) on generalized method of moments estimation. The theory is completed by demonstrating the asymptotic equivalence of the LR test and 2SLS version of the IV test. The chapter concludes by indicating the appropriate extensions of these tests to systems estimation and to models with nonlinearities in the parameters.

Chapter 9 provides a general treatment of LR, Wald (W) and Lagrange multiplier (LM) tests. The framework chosen is that of maximum-likelihood where a subset of coefficients is restricted to be zero. It is then straightforward to relate the asymptotic theory of the LR test to that of the W and LM tests by reparameterizing the constraints in the case of the latter two tests so that they correspond to zero restrictions. Special attention is given to the case of the LM test in single equations where the TR\( ^2 \) form of the test is demonstrated and the multivariate linear model where the W > LR > LM inequality is derived. Some further discussion of the problem of conflict between the three test criteria is provided, indicating that the inequality is uninformative about power. The chapter ends with the tantalizing comment that 'in practice asymptotic theory is a tenuous basis for economic decision making'. Some well-chosen examples would have helped to drive home this point. The chapter would also benefit from a fully worked out illustration, such as the Breusch–Pagan LM test for heteroskedasticity.

The book concludes with a short review of methods of numerical optimization. Gradient methods receive most attention but Gauss–Seidel and conjugate direction methods are also discussed. Most instructors will now find it easy to complement this review with some demonstration exercises using nonlinear optimization and regression packages.

3. ASSESSMENT

Compared with most other advanced texts of econometrics, which run to many hundreds of pages, this is a slim volume. Yet, interestingly, it gives more of the theory of the simultaneous equations model in its few pages than all of the recent texts put together. Of course, this is partly because the emphasis of the book is more highly focused than that of other texts. However, it is also a testimony to the book's success in achieving its own objectives. From the point of view of most students, I suspect that its economy of presentation will be a real asset. The proofs that are given here are usually less than half a page long. They give the rudiments of the arguments and do not impede the exposition with probabilistic details. This means that students should learn quickly and efficiently from the presentation. There is also enough in the way of extensions of the basic model and the classical estimation theory to make the book interesting to informed readers.

The book remains faithful throughout to its central subject—the simultaneous equations model. To some this will make it seem rather passé in its content, given the way in which so many developments of the past decade have moved econometric research away from simultaneous equations. But just as the arena of research in econometrics has widened, the lessons from the theory of simultaneous equations seemed to have deepened. The grounding in fundamentals that this book provides is therefore likely to be of lasting significance.

One thing that these published lecture notes do not provide is a sense of the style and the nature of their presentation. Only LSE graduates will remember the dusty classroom on the second floor of the St Cléments Building, its blackboards awash with equations and estimators decorated by asterisks, tildes, hats and daggers. By tradition, Denis Sargan would lecture for 1 hour and take questions for the next hour after an intervening tea break of 5 or 10 minutes. These lectures were given without notes, and to all those present it was clear that a master-craftsman was at work, one who had himself helped to build much of the edifice that he was describing. Occasionally, there would be a stumble in the continuity of the lecture and students would watch with heightened interest suspecting a slip or nonsequitur in the argument and then gaze in wonderment as the master took a skillful Taylor series expansion and returned with all colours flying to the intended course. Such is now the stuff of memory in the minds of the many men and women who had the opportunity and the privilege to attend the lectures of Denis Sargan. The published lectures will never create moments like these again. But they will serve a pedagogical role by
helping to educate new students of econometrics, and they will stand as a permanent historical record of an internationally renowned training in econometrics that lasted for two decades at the LSE.

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REFERENCES


This book contains the papers presented at the 18th CIRET (Centre for International Research on Economic Tendency Surveys) Conference on 'Contributions of business cycle surveys to empirical economics'. Given that nowadays survey data are widely used in most areas of economic research, from studies of price expectations to studies of consumer or investment behaviour, it is inevitable that the book contains contributions which are very dissimilar. For this reason the papers are presented in separate sections (sessions) each of which is intended to contain contributions concerning relevant data or research areas.

The 18th CIRET Conference was divided into eight such sessions with the important innovation that, for the first time, the opening session—Session 1: 'Keynote lectures on business cycle theory developments'—contains two lectures, one delivered by B. T. McCallum and the other by R. J. Gordon, the intention of which appears to have been to give the Conference an additional theoretical background. In his lecture, McCallum presents the new classical view of business cycle theory by reviewing the main developments in macroeconomic business cycle theory that have taken place in the past two decades. Starting from the Keynesian orthodoxy of the 1960s—and the then-dominant view, according to which what causes supply and demand to differ is some 'nominal price stickiness'—McCallum reviews Lucas's equilibrium approach to business cycle theory. A crucial assumption in the Lucasian equilibrium models of the business cycle is that which states monetary aggregates are not directly observable, i.e. aggregate information is imperfect, during the relevant decision period. This aspect of theories of the business cycle in market clearing models has been strongly criticized, the main reason for this being the fact that in actual developed economies data are available on monetary aggregates too promptly to be consistent with the assumption that individuals are ignorant of contemporaneous monetary magnitudes. This kind of criticism has had a strong impact and has led, on the one hand, to a process by means of which the equilibrium business cycle model of the Lucas type has been transformed into a purely real model, i.e. using Long's and Plosser's (1983) terminology, into a model which describes 'real business cycles'. The major impetus to this line of research was given in the early 1980s by Kydland and Prescott's paper (1982) in which the shocks which affect the economy are random shocks to technologies. On the other hand,