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important protein-rich additive, the dynamism of the Peruvian private sector, and, to some extent, a technological change in fishing made possible by the introduction of nylon nets in 1956. A Leontief-type production function is derived for the industry and the cost structure analyzed in some detail. The major conclusion of this analysis is that beyond a certain threshold output, average costs do not drop markedly. The nature of the cost structure as well as the very high profits available explained the existence of a large number of small and medium sized firms in the industry.

A partial input-output table of the fishmeal industry is built to attempt to measure the backward linkages. In the absence of an input-output table for the economy as a whole, it was not possible to follow through all the indirect effects of fishmeal production. The main direct backward linkages resulting from fishmeal production are shown to have been the growth of a boat and ship-building industry, the establishment of a nylon netting industry, and of a number of domestic firms constructing plants and equipment and producing jute and paper sacks for the fishmeal industry. The forward linkages appear to have been fairly minor.

The effects of fishmeal exports on factor markets were mixed. These exports certainly generated a large inflow of foreign exchange and provided an important opportunity for an outlet to Peruvian entrepreneurs and banks. On the other hand, the direct and indirect effects of fishmeal exports on employment were moderate and the industry does not appear to have altered the extremely uneven income distribution nor reduced the marked dualism between the relatively developed Coastal region and the traditional Sierra.

My overall evaluation of this book is strongly positive. It is an outstanding example of a concrete case study of the impact of a staple export on development. As such it is a welcome addition to a relatively thin literature of strong quantitative and empirical studies of the development process. If I have any criticism, it is that Roemer at times may appear to overestimate the contribution of fishmeal exports to Peru's economic and social development. I have a suspicion that Roemer's initial

hypothesis at the outset of his study was that these exports were making a *major* contribution to Peru's overall development. Upon reading the book, I feel that the latter hypothesis is not supported by the evidence. Certainly the industry contributed to the *growth* of the Peruvian economy but not significantly to its *development*.

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200 Economic Statistics

210 ECONOMETRIC AND STATISTICAL METHODS

Estimating the parameters of the Markov probability model from aggregate time series data. By T. C. LEE, G. G. JUDGE, and A. ZELLNER. Contributions to Economic Analysis, No. 65. Amsterdam and London: North-Holland, 1970. Pp. 254. \$12.00.

In this monograph Professors Lee, Judge, and Zellner are concerned with analyzing (mainly via a Monte Carlo experiment) the properties of several different estimators of the transition probabilities in a Markov chain model. In Chapter 1 they begin by giving a brief description of the Markov probability model: consider a stochastic process in which there are a finite number of possible outcomes or states, which a random variable x_t may take at time t , and assume that the probability distribution of an outcome of a given trial depends only on the outcome of the immediately preceding trial. With each pair of outcomes s_i and s_j is associated a number $p_{ij}(t)$ which represents the probability that $x_t = s_j$ given that $x_{t-1} = s_i$. Such a stochastic process is called a Markov chain and the numbers $p_{ij}(t)$ are called the transition probabilities. It is assumed throughout this book that the transition probabilities p_{ij} are constant for all t , although the case of variable probabilities is discussed in an appendix.

In Chapter 2, the authors derive the traditional maximum likelihood estimator of the matrix of transition probabilities under the assumption that a set of "micro data" exists where micro data are defined as data which give information about which state each individual is in at every particular time period. With micro data, the time path of every individual

can be traced. By introducing a prior density function which has a multivariate *beta* form, the authors obtain a Bayesian estimator of p_{ij} , again under the assumption that a sample of micro data is given. No justification is given for the choice of a multivariate *beta* prior distribution other than the sentence, "This is a rather rich distribution which we believe can represent prior information adequately, in a number of circumstances."

The authors note that frequently sets of micro data are unavailable or are too expensive to obtain, and we are restricted to using "macro data" in which the only information available concerns the total number or proportion of individuals in each state at each time. For example, census data usually give only the frequency distribution of the number of individual units in each size class for each census year and report no information on the time path behavior of each individual. The authors show that it is possible to use the aggregate outcome data as a basis for estimating the transition probability matrix, P , which reflects the behavior of the micro units. In their words, "the purposes of this study are to (1) develop estimators for the elements of the transition matrix P when only aggregated proportion sample data are available; and (2) investigate, within the context of sampling experiments, the performance and distributional properties of the various estimators."

The first macro-oriented transition probability estimator discussed is the unrestricted least squares estimator which is obtained after formulating the model as a classical linear regression model. The estimator is unrestricted because the constraints $0 \leq p_{ij} \leq 1$ are ignored. A restricted least squares estimator is also found by minimizing the error sum of squares in the classical regression model subject to these constraints on the transition probabilities. The finite sample distributions of the estimators of the transition probabilities are unknown so the authors resort to a Monte Carlo experiment to compare the various micro and macro estimators. In their experiment only one 4×4 transition matrix was studied. Micro data was generated for 1,000 individuals over 24 time periods. As the authors themselves point out, any results obtained are limited by

the fact that they have sampled only one point in the parameter space and thus any basis for generalization is severely restricted.

As might be expected, the maximum likelihood estimates based on micro-data are, in general, very close to the true parameters and have frequency distributions which do not differ significantly from normality. The unrestricted least squares estimates obtained from the macro data show up badly as compared to the micro estimates, with some of the estimates being negative. The restricted least squares estimates perform better than the unrestricted least squares estimates but not as well, of course, as the maximum likelihood micro estimates.

In Chapters 5 and 6, new least squares estimators are obtained which take account of the fact that in the regression model the covariance matrix is heteroscedastic. By applying what is essentially Aitken's generalized least squares method, the heteroscedasticity is removed and the new restricted and unrestricted estimators are obtained. Once again the restricted estimates perform better than the unrestricted estimates according to the Monte Carlo experiment. In Chapter 7, another estimator is obtained by minimizing a chi-square statistic. This estimator turns out to be exactly the same as the least squares estimator, which is easier to calculate computationally, so the minimum chi-square estimator is no longer considered.

In Chapter 8, the maximum likelihood estimator based on macro data is derived and in Chapter 9 a Bayesian estimator is obtained, again using a multivariate beta function as a prior density function. The Bayesian estimator performed much better than the non-Bayesian estimator when the prior density function was centered correctly with small variances, and it performed slightly better than the non-Bayesian estimator even when the variances in the prior were large to indicate that little prior knowledge was given.

A final estimator is obtained by minimizing the sum of the absolute deviations in the regression model. On the basis of the sampling experiment, this estimator is inferior to all other estimators except the unrestricted least squares estimator.

A computer routine for calculating the vari-

ous estimators is provided in an appendix and a detailed list of references is given which surveys the literature in the field.

The book is useful in that it provides a basic summary of different estimation techniques and theoretical results which are scattered throughout the literature. The Monte Carlo results are important and interesting but their usefulness is limited by the fact that only one parameter point was sampled and it is not clear how the results can be generalized.

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300 Monetary and Fiscal Theory and Institutions

310 MONETARY AND FINANCIAL THEORY AND INSTITUTIONS

Varieties of monetary experience. Edited by DAVID MEISELMAN. Economics Research Studies. London and Chicago: University of Chicago Press, 1970. Pp. 391. \$13.75.

This collection of six papers could have been titled *Studies in the quantity theory of money "revisited"* except that the mission of popularization of what is now known as *monetarism* was successfully undertaken in the earlier volume. These essays are rather workmanlike papers in the (by 1970) established Chicago monetarist style. For the uninitiated, this means empirical work (self-consciously called "hypothesis-testing" at Chicago) in which one seeks to establish firm values for the parameters of simple macroeconomic models where the quantity of money, however defined, is given a central role.

Aside from a tendency to follow a common outline—which consists of problem, model, institutional orientation, and empirical tests, followed by a data appendix—these studies have remarkably similar theoretical dispositions. Most importantly, the intellectual input—in terms of the actual models employed in the empirical tests—is based on a half dozen standard monetarist sources. John V. Deaver's study of Chile and Colin D. Campbell's study of Korea and Brazil use Friedman's and, especially, Cagan's models from the earlier Chicago Collection. Adolfo Cesar Diz' study of Argentina uses Cagan of the *Studies* and, for a sup-

ply relationship, Cagan's formulation in the *Determinants and effects*. George Macesich, in his study of Canada, leans on Richard Selden's paper in the *Studies* and on later demand for money studies by Meltzer, Chow, and Laidler. The other two papers, Michael W. Keran's on Japan and Morris Perlman's on the liquid portfolio differences among 47 countries, do not fit so neatly into the pattern, although they are monetarist by the definition given above. Keran's model is not a simple one and is also "open," while Perlman's is almost totally *ad hoc*, some interesting theoretical work notwithstanding.

The studies are somewhat dated by now, with the earliest of them, that by Deaver, completed in 1961, and the latest, that by Macesich, in 1967. Thus, expectations are generally estimated by a simple exponential series, and the models are usually single equations. When other equations are present, they too are fitted as single equations, with the parameters used as if they are from the structure. The lag in the production of this volume is unfortunate for the contributors whose efforts, often as good as anything in print at the time their work was finished, must now be judged primarily useful to specialists on the various countries studied.

Deaver's paper is a direct extension of Cagan's hyperinflation model. Cagan's paper had the demand for real balances as a function of the expected rate of inflation; no doubt the model worked as well as it did because it was applied to cases of hyperinflation. In Deaver's case, the rate of inflation was more modest; consequently, an income constraint, both measured and permanent, improved the fit of the model substantially.

The Diz project, of a later vintage, represents a direct improvement over Deaver's in that it has both a supply and demand for money. The behavior of the reserve ratio seems to dominate the movements in the banking multiplier; in turn, these changes seem to be the result of bank responses to various legal changes. The behavior of the policy variable—required reserves—not only does not contribute significantly but may have simply been altered to offset *previous* changes in the legal reserve ratio. Diz' work on the demand for money successfully adds another variable, the