

and most of the wasteful, inefficient exploitation had already taken place. This is really a startling outcome. Tremendous joint benefits were available, the institutional technology to achieve those benefits was well known, and still the operators could not reach a cooperative solution. Private solutions were thwarted by the inability of surface owners to agree upon a sharing formula. The owners' failures were not confined to private contract. They could not successfully resolve their problems with the state's assistance. Libecap attributes their failure, both private and public, to the existence of a large number of surface owners and, less obviously, to their asymmetric information regarding the field's productivity.

The great irony in oil policy is that private ownership exacerbated the problems. In Wyoming, where most of the oil was on land owned by the federal government, the bulk of production came from unitized fields. Private firms developed the property under long-term leases and the terms of the lease encouraged unitization. In Texas, on the other hand, most of the land was in private hands before oil was discovered, and the separate owners found it too difficult to agree on a cooperative solution.

The discussion of federal timberland in the Northwest illustrates a different set of problems. The starting point was a federal land policy that restricted distribution of the land to bona fide settlers and limited them to 160 acres (at an arbitrary, below market, price). Efficient exploitation of the timber resource required considerably larger land holdings. (Weyerhaeuser, for example, purchased over 900,000 acres directly from the Northern Pacific Railroad.) Land could be obtained from the government in 160 acre parcels at a price of \$1.25 or \$2.50 per acre (depending on the statute), subject to certain restrictions on use and resale. With the market value of the land (if a timber company could exploit it effectively) at about \$7 per acre, there were obvious potential gains from trade. Or, more precisely, gains from fraud. By utilizing a network of "entrymen" and agents, timber companies could acquire considerable holdings—the California Redwood Company, for example, acquired 57,000 acres. Libecap suggests that about half the claims for timberland in the Northwest were fraudulent.

Because of these dubious origins, title was insecure. Owners therefore had an incentive

to exploit the resources inefficiently. The political response largely ignored the efficiency question and focused instead on the size of the holdings of the timber companies. A coalition of homesteaders (who wanted to keep the 160 acre maximum) and conservationists ultimately prevented much of the federal holding from ending up in the hands of large timber companies.

This brief book brings together some very interesting material and packages it in a provocative and thoughtful way. Having read the book right after a brief visit to Moscow, I found myself trying to apply Libecap's lessons to the Eastern European transition. That is a depressing exercise. If a society that is basically hospitable to free market notions does so badly in privatizing property, this does not bode well for marketization in a more hostile milieu.

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Uncertainty: A guide to dealing with uncertainty in quantitative risk and policy analysis.

By M. GRANGER MORGAN AND MAX HENRION with a chapter by MITCHELL SMALL. Cambridge: Cambridge University Press, 1990. Pp. xii, 332. \$44.50. ISBN 0-521-36542-2.

JEL 91-0049

Recent research in the area of risk and uncertainty has reflected a multidisciplinary orientation. Scholars from decision sciences, psychology, and economics have been among the leaders in recent research developments. An important component of this research has been risk analysis, particularly with respect to scientific and technological risks. *Uncertainty* is a risk analysis textbook that Granger Morgan and Max Henrion have written to serve as a basic text for students as well as a reference work for practitioners and researchers. *Uncertainty* succeeds both in providing an excellent basis for policy analysis and in drawing upon a variety of case studies that will be of interest to risk researchers.

The first two chapters are motivational in nature. They indicate the intrinsic nature of scientific and technical uncertainty in a variety of contexts, and they provide extended discussions of reactor safety, air pollution, and ozone and chlorofluorocarbon regulation. Their discussion of these cases reflects the emphasis of the book, which is on how analysts should formulate policy assessments of these risks. Al-

though the authors acknowledge the role of benefit-cost analysis, the book is not concerned with benefit valuation, only with understanding the underlying uncertainties and structuring the overall decision analysis problem. Consequently, economists will find that this book deals with an important component of policy analyses in the risk area, but that it does not substitute for a treatment of the economic literature. Thus economics professors will find it most useful as a supplementary text addressing the scientific basis for regulatory policy.

The authors summarize the essentials of policy analysis in the risk area in Chapter 3. This discussion reviews alternative objectives that the government might have. Most economists no doubt would choose a different emphasis that placed greater weight on benefit-cost analysis, but the discussion of alternative policy objectives is reasonably complete. The highlight of this chapter is the ten commandments for sound policy analysis presented by the authors, which includes advice such as "let the problem drive the analysis" and "perform systematic sensitivity and uncertainty analysis" (p. 37). These ten commandments will provide a useful checklist for students and practitioners alike.

Chapter 4 introduces the book's Bayesian perspective. Although the general approach is normative, the authors recognize that in practice there are often errors in the way that uncertainty is treated. Drawing upon the research of Max Henrion and Baruch Fischhoff, the authors cite tendencies such as the proclivity toward underestimating the size of systematic errors in the analysis.

The analytical core of the book consists of Chapters 5–8. Chapter 5 provides an excellent brief overview on the use of eleven commonly used probability distributions. The main purpose of this discussion is to acquaint readers with the essential properties of all of the principal distributions that frequently appear in the context of risk analysis. The brief treatment will enable readers to be informed consumers of statistical analyses employing these distributions, but to become practitioners or frontier researchers, additional background will be required.

In a similar vein, Chapter 6 provides a summary of the essentials of the psychology literature as they relate to risk analysis. Overviews of this type have proliferated in recent years.

This particular treatment places less weight on choice-related anomalies and more weight on perceptual anomalies than others that are available.

One of the well-known results cited by the authors is the tendency of people to overestimate low-probability events and to underestimate the larger risks that they face. This is one area in which the authors and their students at Carnegie-Mellon have also done innovative work in terms of replicating the original work in this area. Although the authors integrate much of their research into their discussion in the book, for the risk perception topic I would have liked to have seen more treatment of their own work, which is likely to be less familiar to the readers than the much more frequently cited results by Sara Lichtenstein et al. Granger Morgan and Max Henrion's discussion of explanations for the observed biases in risk perceptions somewhat surprisingly omits possible Bayesian explanations for these phenomena. For example, if individuals assess all risks initially as being equal and acquire partial information about the risks that they face, one will observe a tendency to overestimate small risks and underestimate large risks because the extent of the learning is incomplete.

Those undertaking risk analyses inevitably have to draw upon the scientific views of others. The focus of Chapter 7 is on how one should interview experts concerning their subjective assessment of the risks and integrate these differing expert views into a sound risk analysis. The focus of this chapter is practitioner-oriented, and it is illustrated with several case studies. This approach contrasts with a more formal Bayesian method for integrating differing beliefs, which the authors allude to but appropriately recognize as usually being infeasible.

Because of the underlying uncertainties involved, risk analyses inevitably are based on assumptions that are often the object of debate. Chapter 8 focuses on how researchers should undertake sensitivity analyses in these situations. In addition to providing useful background information on how one can employ approximations such as a Taylor series expansion in such instances, the authors propose several measures for exploring the sensitivity of the results to the key assumptions of interest. Unfortunately, in many risk analyses our uncer-

ainties may be so great that establishing meaningful estimates of the standard deviation of certain parameters may go considerably beyond the state of our current knowledge. We could assess these distributions subjectively, following a procedure that the authors recommend, but in practice policy analyses often do not do this because of the staggering process by which the uncertainties are compounded in the steps of the risk analysis.

The final four chapters of the book deal with how one should display probability distributions, computer aids for modeling, and the determination of the size and complexity of the model. For the most part, these chapters are likely to be of greatest use to practitioners of risk analysis rather than students and researchers.

Overall, *Uncertainty* serves as an excellent supplementary text for economics courses in risk analysis. The subject matter is drawn primarily from the fields of decision sciences, engineering, and policy analysis. Economists consequently will find this book a useful adjunct to more economics oriented treatments of risk analysis issues.

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The structure of earnings and the measurement of income inequality in the U.S. By DANIEL J. SLOTTJE. Contributions to Economic Analysis, no. 184. Amsterdam; Oxford and Tokyo: North-Holland; distributed in the U.S. and Canada by Elsevier Science, New York, 1989. Pp. xii, 206. \$65.00. ISBN 0-444-88320-7. JEL 90-0879

Research on functional and personal income distributions is receiving an increasing interest in the economics and econometrics literature. The functional income distribution deals with factor prices and their impact on factor shares in national income whereas the personal or size distribution is concerned with flows of income, e.g., national income, among a set of microeconomic units. The set of microeconomic units can be partitioned according to socioeconomic attributes, such as sex, education, age, and occupation whereas the income of the receiving units can be disaggregated by sources, such as labor, property, and transfers.

Since Vilfredo Pareto's (1895) seminal contribution on income distribution by size, this

strand of research has been more intensively explored than that of functional distribution. Distinguished scholars from different scientific disciplines continued Pareto's research. These scholars have included Corrado Gini, Simon Kuznets, Henry Theil, Anthony Atkinson, and Jan Tinbergen among statisticians and econometricians; Francesco Cantelli, Maurice Frechet, Faffaello D'Addario and Benoit Mandelbrot among mathematicians; and Francis Edgeworth, Luigi Amoroso, and Maurice Allais among economists.

This book presents a detailed quantitative study of the distribution and inequality of earnings in the United States during the 1975-84 period. The introduction gives a clear and concise description of the topics to be discussed and emphasizes the strong interdependence between production and distribution. An analysis of this interdependence, and the identification and explanation of the basic forces contributing to the outcome of macroeconomic processes are beyond the scope of this study, falling within the frontier of economic research.

Chapter 2 deals with observed trends and structural changes in U.S. labor market from the late 40s to 1984. The remaining six chapters discuss several measures of income inequality and their properties as well as Karl Pearson's methodology for the identification of probability distribution functions. Extensive applications to American data are provided.

Discussion of income and labor earnings distributions are embedded in an appropriate methodological context when Slottje discusses three of the most important areas of current research, namely, (a) theories accounting for observed income and labor earnings distributions; (b) the specification, evaluation, and properties of a subset of income distribution models; and (c) measures of inequality and their properties. In this context, Slottje rightly observes that the "lack of a satisfactory theory of personal income distribution is a problem that economists have pondered for most of the twentieth century" (p. 55). Nevertheless, we have to acknowledge that several penetrating insights have been advanced since Pareto's (1897, 1916) circulation of the elites and Gini's (1909, 1952) demographic and neo-organicist theories. Most of the explanations given for the observed generation of income and earnings distributions are unidimensional, such as ability, individual