

*Causality: Models, Reasoning, and Inference.* By JUDEA PEARL. Cambridge University Press, Cambridge. 2000. xi + 384 pp. £25.00.

Few would disagree with Pearl that causal knowledge is often more useful than associational knowledge. We spend resources on HIV prevention because HIV has been shown to cause AIDS. Legal responsibility for a death may be established by determining the cause of death. Economists contemplating policy interventions need policy instruments that cause economic outcomes. The formalisation and analysis of causality, however, is controversial. The main thesis of this book is that this controversy is due to the lack of a proper framework for causal analysis. Its contribution is that it provides such a framework.

Pearl centres his work around structural models, which are systems of structural relations between variables. The structural relations are autonomous in the sense that

© The London School of Economics and Political Science 2003

they are invariant to interventions elsewhere in the system. It is this autonomy that allows us to compute the causal effect of interventions that change the way one set of variables is determined on another set of variables. In the leading case that the models are recursive, they can be represented by directed acyclic graphs, in which the nodes represent variables and the vertices relationships between variables. Arrows indicate the direction of causality in a structural relationship. The graphical representation of causal structure naturally leads to mathematical methods for analysing causal claims based on existing graph and probability theory.

Pearl takes his structural models to be fundamental. Causal queries are settled by rigorously deriving the implications of a structural model. This is bound to raise controversy among philosophers and statisticians, but may come natural to economists: the models used by Pearl are essentially non-parametric versions of the linear models studied by economists of the Cowles Commission. The structural approach allows Pearl to offer a unified perspective on an impressive range of issues. One example is the notorious Simpson's paradox (Chapter 6). This paradox would not be recognized as such by anyone who takes either a purely probabilistic perspective or an explicitly structural perspective like Pearl's. Tension arises only if causal answers are pursued by purely statistical means. Another example is the confusion surrounding the connection between token-level and type-level causation (Chapter 10). These concepts are easy to relate if we are willing to maintain Pearl's structural framework.

The Preface notes that the book is roughly organized in the chronological order of Pearl's work. Pearl promises that this recreates for the reader the excitement that he and his co-authors felt in developing their ideas. A drawback is that the book is occasionally repetitive and, arguably, slightly less concise than it could otherwise have been. An economist who is only incidentally interested in causality may be willing to forgo Pearl's excitement and use the reading guide in the Preface and the extensive name and subject indices to track down the more directly relevant sections of the book. Such an economist, like any reader of the book, will benefit from the Epilogue; this contains a public lecture that provides a nicely illustrated non-technical overview of the main issues.

Econometricians can find discussions related to their work in various places. The concept of exogeneity is reviewed in Chapter 5. Chapter 8's discussion of bounding causal effects relates to a growing body of work in econometrics. The analysis of recursive non-parametric structural models, which has recently attracted attention in econometrics, is central to the entire book. The Neyman-Rubin potential-outcome model, which is now routinely used in the econometric analysis of simple economic programs, is provided with a structural perspective in Chapters 3, 5 and 7. The methods in this book for handling more complicated graphs may be useful in the evaluation of more complex economic programs.

This being said, economists wishing to apply some of Pearl's methods to economics may occasionally be puzzled. The leading economic example is a simple supply and demand model. In Pearl's structural representation, prices are determined by quantities in a supply equation and quantities are determined by prices in a demand equation. A supply intervention then necessarily amounts to a price intervention. Economists, however, may also be interested in other market interventions such as supply rationing. Economists can analyse such interventions because demand schedules can be reinterpreted as giving the marginal price that consumers are willing to pay for a given quantity of goods. This raises the more general question of how useful Pearl's structural approach is if we already have specified an economic model based on economic primitives such as preferences and technologies. Such models can often be translated only in fairly trivial systems of autonomous equations which make up Pearl's structural models.

In all fairness, we should not expect a book as broad in scope as this one to provide an in-depth guide to economic applications. K. D. Hoover (*Causality in Macroeconomics*, Cambridge University Press, Cambridge, 2001) may provide useful complementary (and, occasionally, conflicting) reading.

*Free University Amsterdam*

JAAP H. ABBRING