The Australian Journal of Agricultural and Resource Economics, 49, 339–367

Book reviews

Beyond Drought: People, Policy and Perspectives, edited by Linda Courtenay Botterill and Melanie Fisher. Published by CSIRO Publishing, Melbourne, Victoria, Australia, 2003, pp. xvi + 229, ISBN 0 64306 954 2 (pbk), $A39.95.

Drought is a naturally recurring business risk for Australian agriculture producers. Australian agricultural economists and policy analysts, in general, accept this. This proposition is core to a recent publication, *Beyond Drought: People, Policy and Perspectives,* where the authors come from diverse professional backgrounds of economics, political science, climatology, environmental science, journalism, social science and public service. Some authors also draw on international experience. The diversity of professional orientation runs the risk of this collection of contributions degenerating into a confusing collection of inconsistent articles. However, in this book, there are three key themes that have been highlighted by the editors in the introduction:

- Australian agriculture, the community and government need to 'learn to be Australian' to deal with drought effectively;
- Drought is not only a climatic phenomenon but also a social, political and economic one; and
- There are many possible ways of dealing with drought but no one correct drought policy.

I will deal with these themes one by one, concentrating on content and implications for drought policy. I will also ignore issues about structure to focus on the merits of the arguments. In this book review, I will not be giving equal space to each chapter but will instead focus on those that contribute most to the drought policy debate in terms of understanding the institutional context. This is not a judgement on those articles I neglect; it merely reflects my bias in concentrating on the institutional aspects of drought policy.

'Learning to be Australian' means learning how to cope with Australia's variable climates instead of importing European methods of agriculture production. Agriculture in theory reduces the food supply risk by creating a stable supply of food compared to hunting and gathering. But in Australia's volatile climate, agriculture may be the risky option (Peter Hayman and Peter Cox, Chapter 8). Drought is an unpredictable phenomenon that can have serious consequences for producers and local communities but it is a risk that can be ameliorated by prudent farm management. Producers cannot influence the risk of drought but can manage the damage suffered by the farm enterprise through various means such as minimising the ecological impact of farming practices (Asa Wahlquist, Chapter 4; Daniela Stehlik, Chapter 5; Bruce O'Meagher, Chapter 6; Mark Stafford-Smith, Chapter 7). However, current State and Commonwealth government policy implicitly assumes that drought is an aberration rather than a recurring

risk of operating an enterprise in Australia's volatile climate (Stafford-Smith, Chapter 1; Janette Lindesay, Chapter 2; Botterill, Chapter 10). The belief that drought (and other climate extremes) are unusual and rare, serves as a disincentive for producers to prepare for drought. This is reinforced by governments' inability to resist calls for assistance – that is, moral hazard is perversely encouraged by governments' lack of commitment to the stated policy objective of the national drought policy (NDP) goal of encouraging 'self-reliance'.

In Chapter 3, Botterill argues that the NDP as a policy institution is flawed because it essentially institutionalises political lobbying by producers. This problem partly stems from the design of the drought declaration process and also the Australian constitution that delegates agriculture as a State responsibility. Essentially, producers initiate drought declarations by requesting State governments to write a submission supporting declaration in their region. This is then submitted to the Commonwealth that reviews and determines if the case warrants drought declaration. Despite the States having constitutional responsibility, the Commonwealth finds itself footing the bill for drought because the States have no incentive to properly examine the producers' case. If Botterill's analysis is correct, it is a first step to diagnosing the drought institutional problem. Using the language of game theory, this lack of credible commitment by the government inadvertently perverts producers' incentives to prepare for drought. This argument is supported by some of the authors in this book (Botterill, Chapter 3; O'Meagher, Chapter 6; Stafford-Smith, Chapter 7). As a result, current drought policy arrangements provide perverse incentives to producers to not 'learn to be Australian'.

Drought is often viewed as a purely climatic phenomenon with devastating economic and social consequences for affected producers. However, this view ignores the politics of drought and how this affects implementation of drought policy. Asa Wahlquist (Chapter 4) recounts how the Australian media galvanised public opinion during the 1994–1995 drought to pressure the Commonwealth and State governments to provide additional drought assistance to drought-affected producers on top of the NDP assistance. Wahlquist's chapter stands out in this book because much of the source materials are interviews with important players in the media such as Ray Martin (from channel 9's *A Current Affair*), politicians (e.g., Tim Fischer) and key farm leaders. The media is a potent tool for farmers' lobbies to influence government policy especially if the media is on their side. This is especially true during drought. For example, Ray Martin in 1994 helped raised donations for affected producers and implicitly portrayed the Commonwealth government as uncaring for doing nothing.

Wahlquist's chapter, along with Botterill's Chapter 3, highlights the political nature of drought and how this impacts on the social gains/costs of drought policy. Although agricultural economists pay lip service to the political aspects of drought policy, there has been no formal incorporation of the political 'reaction functions' (to use the language of game theory again) of the main players in the economic analysis of drought. By ignoring political aspects in an economic analysis of drought policy (whether positive or normative), any implications drawn are likely to be erroneous or to be

rejected by politicians as unworkable or, in the words of Sir Humphrey from *Yes Minister* as 'very courageous'.

Daniela Stehlik in Chapter 5, stresses the social aspect in describing how drought-affected producers coped with drought in central Queensland and western New South Wales. Stehlik argues there is a role for government in 'enabling' producers' 'resilience' by recognising the heterogeneity of producers, feelings of isolation from urban Australia, the intense 'lived experience' of drought, that producers are adopting information technology for management (and other innovations), the importance of spousal and family relationships, the role of intergenerational concerns and the impact of decline of services in rural areas. These points are confusing as on the one hand, for example, drought is an intensely traumatic experience for the producers yet from the same sample they were finding ways of managing the impact of drought by using information technology to manage their enterprises more efficiently. It is not clear if producers are passive victims of circumstances beyond their control (which seems to contradict the general tone of this book) and therefore require government assistance or whether they are clever innovators who could possibly find a way to deal with drought. Wahlquist (Chapter 4) supports the latter point when she describes the media's indifference to the stories of producers who were able to manage drought through destocking and careful management of inputs. This suggests that Stehlik's analysis could be improved by concentrating on the heterogeneity in producers' ability to cope with drought. As for the arguments that government intervention is needed to support the resilience of drought-affected producers, Stehlik does not present a robust case because many of these producer concerns appear to be best solved by the producer themselves rather than by government.

O'Meagher (Chapter 6) presents the economist's strong argument against government intervention during drought. Simply put, there is no market failure involved, and government assistance may reward producers who did not prepare for drought. He recognises that government's lack of commitment to the NDP's objective of self-reliance has encouraged moral hazard. Without much regard for political issues, O'Meagher concentrates on mechanisms such as Farm Management Deposits and a HECS-style scheme to support producers.

The policy economist's focus on mechanisms to solve the drought policy problem may be misleading because it does not deal with the perverse incentives of the NDP. However, the NDP is not the only source of perverse incentives. Stafford-Smith (Chapter 7) uses a model that incorporates a biophysical component with a farm management one to show how some primary producer provisions in the Australian tax system can lead to undesirable drought management decisions and negative environmental impacts. The modelling results are supported by anecdotal evidence from interviews with rangeland producers. Stafford-Smith sets the scene by calculating the net productivity loss of rangeland agriculture production at $A100 million per annum and the tax revenue loss at $A250 million per annum. These estimations are before any cost of drought payments by State/Territory and Commonwealth governments are factored in.

Stafford-Smith's research results suggest there is a systemic agriculture policy failure where drought policy problem is one symptom of it. The author argues that

decentralising drought management decisions to producers would be preferable than the use of distortionary instruments such as tax incentives. Specifically, Stafford-Smith proposes the establishment of regional-based agriculture institutions to manage drought policy. To me, it is not clear what is meant by 'institutions' in this context as in economics the meaning of this word is quite specific – that is, institutions define the boundaries of a firm/organisation/individual's actions. Stafford-Smith also supports learning as part of policy but at a regional/enterprise level. However, these recommendations ignore the possibility of free-riding, the high transaction costs of organising producers into a cooperative unit, and the potential for rent-seeking pressures to be more intense at regional levels.

Donald Wilhite (Chapter 9) proposes planning as a way for governments to manage drought. Drought plans involve three main components:

- Monitoring, early warning and prediction of drought;
- Risk and impact assessment; and
- Mitigation and response.

Wilhite argues that drought plans have been successfully applied. However, no criteria for evaluation were presented to assess this claim. Wilhite also suggests that the NDP is on the right path to implementing drought planning. This seems like a strange statement given the otherwise unfavourable view of NDP in this book. Although there is nothing wrong with the nominated components of a drought plan, Wilhite does not show how the NDP can solve the incentive problems for government and producers in dealing with drought. However, Wilhite does make an important point that whichever institution is used to manage drought, organisational learning should be incorporated to prevent past mistakes being repeated.

Clearly, there are many ways to fix each facet of the drought policy problem but there is not an elegant solution that can simultaneously mend the institutional, political, incentive and environmental problems. Any meaningful reform of drought policy needs to encompass all these aspects to have a lasting impact.

Beyond Drought contains diverse views on why drought causes policy problems. Adverse impacts on agricultural production are not the only reasons drought causes public policy problems. The political and environmental aspects of drought policy also cause major concerns and policy failures. The authors of *Beyond Drought* argue that part of the problem is the use of European agriculture techniques that were not adapted for Australian conditions and the untenable belief that droughts are rare occurrences. Drought is also multifaceted in the sense that drought not only causes agriculture production to fall but also may be associated with land degradation and pressure on governments to spend taxpayers' money for supporting drought-affected producers. Finally, because drought is a multidimensional problem, solving the drought problem requires more than implementing a policy but also institutional reform. *Beyond Drought* provides a useful reference on the institutional context of drought policy and highlights the impact political pressure has on policy – aspects of policy that economists tend to disregard in policy analysis and design. *Beyond Drought* is a useful

reference for this reason and should be required reading for all policy and natural resource economists.

ARTHUR HA
Economics and Policy Research Branch
Strategic Policy Division
Victorian Department of Primary Industries

The World's Wine Markets: Globalization at Work, by Kym Anderson. Published by Edward Elgar Publishing, Cheltenham, UK, 2004, pp. xviii + 335, ISBN 1 84376 439 3 (hdbk), £95.00.

In this volume, Kym Anderson has collected together wine market analysis by key researchers in the field and presented it in the context of both an economic history and a prognosis for the future. The selections provide a readable survey of the industrial organisation of the world market covering all main producing regions and how they interact. Anderson illustrates the growing globalisation of the market and discusses how this globalisation has contributed, and will continue to contribute, to the distribution of declining favour and rising fortunes in this market. The authors here understand that wine is no ordinary product. There is a mystique to both the supply and demand for wine that may not be easily defined, but can draw interested readers on many levels from academic to investor to interested lay person. There is a general curiosity about wine not only because of the mystique factor but also because wine is one of those commodities that combines technology and art in production, and is sold to consumers who hold a complex preference set that can challenge the assumptions of neoclassical theory. Throughout the stories told in this book we might ask: where is the rational individual when it comes to wine selection? The authors collected here address this question in the context of both regional markets and the world as a whole with a scholarly and analytical approach that is nevertheless laced with the anecdote and speculation that comes with understanding wine and its evocative input to well-being.

This book is divided into four parts including an overview in Part I. Part II contains surveys of the Old World markets of France, Italy, Spain, Portugal, Germany, the UK, the Nordic Countries, Eastern Europe and the Former Soviet Union. Part III contains surveys of the New World countries including North America, South America, South Africa, Australia and New Zealand, while in Part IV, the focus turns to emerging markets in East Asia.

Part I provides an overview of the world market and a taste for the rest of the book. The observation that provides a common thread throughout is that there is evidence that there is increasing globalisation of the world wine market, and it is this reality that will drive future change in supply and demand. Global trade rose by 5.4 per cent per year in volume terms from 1988 to 2001 despite the fact that there had been zero growth in aggregate world production and consumption during that period (p. 24). Within that trend, overall per capita wine consumption has fallen by

1.0 per cent per year over the 1990s with consumption shrinking in traditional wine producing countries and expanding in non-producing countries in Europe, East Asia and the New World. After the first chapter sets the scene, Chapter 2 provides a more in-depth analysis of the global market and the remainder of the book provides detailed market analysis for the individual countries and regions.

The second chapter, which forms the solid foundation for the book, is by Kym Anderson, David Norman and Glyn Wittwer. The authors build on the introduction by providing a detailed description of the industrial organisation of the world wine market, the changing pattern of supply and demand and price projections based on an intensive descriptive study of world wine statistics over the period up to 2001, an impressive data set and a world wine model. On the demand side, there have been demand shifts away from Old World wines and towards New World wines, a shift towards more premium qualities and an observed increased preference for red wine; presumably in response to health reports that constituents present in red wine contribute to improved cardiovascular health. Attempts by governments to shape the industry over centuries of intervention are not neglected here or throughout the book. On the supply side, Australia is highlighted with reference made to the comparative situation of Australia in production and trade and the trend of growth as a wine exporter relative to other new world producers and traditional producers in Europe.

The second half of the second chapter provides the book's main empirical analysis with forecasts for the world wine market to 2005 based on a partial equilibrium model of world supply and world demand using 1999 data for 47 countries/country groups for wine from three quality classes: non-premium, commercial premium and super-premium classes, as determined by price as the quality indicator. The model is designed so as to provide price predictions for the three quality classes and, therefore, it includes input commodities and endogenous outputs for the 47 countries/residual regions. This disaggregation allows for predictions of the trend in premium and non-premium segments of the world wine market. Systematic sensitivity analyses are provided for changing parameters, growth and policy uncertainty on outcomes. The model itself is informed by market intelligence about issues such as the past trend of expanded premium vine plantings in the New World and Old World, substitution possibilities among inputs, trends in demand away from white wine and towards red, trends towards premium and away from non-premium consumption and a strong response to advertising campaigns.

Predictions include an increase in exports, rising shares of New World exports, rising export values generally, declining real average producer prices, declining per capita consumption in traditional markets and rising in emerging markets, declines in non-premium wine consumption and continued quality upgrading. Resulting prices for non-premium wine are flat on average, based on small net increases in demand that are met with reductions in supply as producers switch to concentrate on premium production. The sensitivity analysis provides insight into the regional and price impact of slower growth in household expenditure, slower growth in winery processing capacity and the combined effect of both. The authors suggest that their aim is to provide an indication of the relative contribution of different factors. They also acknowledge

that the predictions depend on the underlying model assumptions. They offer their predictions as useful input to understanding how prices might move on average, based on a model of supply and demand that accounts for regional supply and demand and a heterogeneous product.

Parts II and III provide descriptive surveys of wine markets for countries and regions according to their histories, production, consumption, market structure, trade, important policies, such as taxes and subsidies and market prospects. In each case the facts and trends in production and consumption patterns are evaluated with a view to providing recommendations for a more successful future.

Part II takes the reader through the story of the Old World wine markets, their growth and lost global markets for some, declining domestic table wine demand and learning to adapt old systems to new circumstances and quality demands. Each analysis addresses the key ingredients of success, given increasing globalisation and a market where it is becoming more and more the case that it is just not good enough to be good at making wine and that comments from revered wine critics can make or break fortunes. The response is a tale of learning to adapt in a world market where consumer preferences are not always readily known in distant regions, relative prices matter when there are many emerging good quality substitutes and marketing must adhere at the same time to volume demands by distributors and variety demands by ultimate consumers.

Part III provides the key ingredients of the successful emergence of New World producers in an increasingly more sophisticated consumer market. Kym Anderson's chapter on Australia is comprehensive in its history with predictions for the future based on both a thorough understanding of the Australian market, potential export markets and on the analytical model used in Chapter 2 for world markets. Based on his analysis, Anderson's prediction is for falling average real prices at home and abroad. In order to stem the price declines, his advice is to resist impediments in export markets, including taxes and non-tariff barriers, to stay flexible in response to supply and demand shocks and to improve both marketing efforts and marketing sophistication. It is a good read and, in Australia, this chapter goes a long way in explaining the 'great uncertainty and ever-fluctuating fortunes' that have been leading headlines here for the wine industry.

As a final section, Part IV surveys the East Asia frontier for wine production of both domestic and imported grape inputs and consumption, where per capita consumption is low but growing. The focus is on China and Japan and the topics include direct foreign investment potential, tariff barriers, quality control issues, government bureaucratic impediments to trade and the challenges of integrating into the international market.

The work brought together in this volume is basic to any future study of wine markets. It reports on the important facts of economic history and provides an applied economic analysis of the global wine market. It involves many of the key researchers in the field and it is the starting point to improve understanding of this market: how it works and how it demands change. The material presented both answers a number of research questions and stimulates more.

This book is informative and useful, and will be a good read for industry members, economists, students and others who are drawn to economic history, industrial organ-

isation and applied economic analysis. It is an excellent summary about how a global market for wine has come to be, how it is surviving and how it may evolve.

BRENDA DYACK
CSIRO Land and Waterm, Canberra

Auctioning Public Assets: Analysis and Alternatives, edited by Maarten C.W. Lanssen. Published by Cambridge University Press, Cambridge, UK, 2004, pp. XX + XX IBSN 0 521 53757 6 (pbk), $79.95.

Governments routinely allocate access to crown resources and infrastructure. These decisions have clear implications for economic efficiency, the distribution of wealth and can have political ramifications. It is in this context that the book *Auctioning Public Assets: Analysis and Alternatives* provides valuable reference material for those involved or interested in resource allocation processes. This book is a compilation of papers, edited by Maarten Janssen, that deal with the theory and application of auctions to public sector assets. There are two parts to the book. Part one consists of five chapters that focus on theoretical concepts relevant to auction design. Part two contains seven chapters that describe, analyse and evaluate the performance of various applications of auctions to public sector resource allocation problems. The chapter authors and headings are summarised as follows:

1. Tilman Borgers and Eric Van Damme, *Auction theory for auction design*
2. Maurice Dykstra and Nico Van Der Windt, *Beauty contest design*
3. Timothy C. Salmon, *Preventing collusion among firms in auctions*
4. Emiel Maasland, Yves Montangie and Roger Van Den Bergh, *Levelling the playing field in auctions and the prohibition of state aid*
5. Maarten Janssen and Benny Moldovanu, *Allocation mechanisms and post-allocation interaction*
6. Timothy C. Salmon, *Spectrum auctions by the United States Federal Communication Commission*
7. Emiel Maasland and Benny Moldovanu, *An analysis of the European 3G licensing process*
8. Tanga Morae McDaniel and Karsten Neuhoff, *Auctions of gas transmission access: the British experience*
9. Joseph Swierzbinski and Tilman Borgers, *The design of treasury bond auctions: Some case studies*
10. Benny Moldovanu, *Matching markets*
11. Maurice Dykstra and Jaap De Koning, *Competitive procurement of reintegration services in the Netherlands*
12. Luisa Affuso and David Newbery, *The provision of rail services.*

The first observation about part one of the book is that relevant theoretical concepts are explained in a very accessible manner. Although auction theory can be complex, the

editor has chosen to pitch the book at an operational rather than theoretical level. Key concepts are illuminated in a relatively simple and non-mathematical form that will appeal to some and not to others. In this respect the book fills an important gap – to assist public administrators to become aware of the importance of designing auctions to suit the purpose for which they are intended and to increase awareness about the hazards of poor allocation processes. The book does not set out to provide a 'DIY' auction design manual and should not be approached in this way.

The book does provide a discussion of the important design decisions faced by public administrators interested in establishing efficient allocation mechanisms. The subject matter covered here includes pre-auction decisions and design, choice of auction format involving single and multiple-unit allocation problems, reserve price strategy, collusion etc. One chapter is devoted to the characterisation and analysis of the 'beauty contest' approach to allocation problems. Although most economists correctly dismiss this approach because it lacks objectivity, the book correctly reminds the reader that there are certain situations where this approach is relevant and appropriate, such as architectural design competitions.

The theory section of the book dedicates one entire chapter to collusion. In this chapter, the reader is alerted to the factors that predispose collusive behaviour including auctions involving multiple items, small numbers of bidders and situations where bidders have diverse preferences. A review of literature is used to summarise strategies available to limit the harm caused by collusion and to identify the alternative auction formats that might be used to minimise the possibility of collusion. These include sealed-bid formats for single-item auctions, sequential sealed-bid and combinations of auction formats such as the Anglo-Dutch hybrid auction. This area of auction design continues to attract research by economists using experimental approaches. This chapter documents the well-known example of collusion evident in the early FCC spectrum auctions. In these auctions, bidders were able to collude through a process called 'bid signalling with trailing digits'. Finally, the reader is alerted to the trade-offs, with respect to economic efficiency and revenue, that need to be considered as a consequence of managing collusion.

Two important general messages can be drawn from the theory part of the book. The first is Klemperer's maxim about auction design 'one shoe does not fit all' and the second is that auction design is clearly a complex and evolving discipline where a little knowledge could be a dangerous thing.

The second part of the book examines some of the many applications of auctions to public sector allocation problems. Seven case studies are examined including the FCC spectrum auction in the USA, several of the European 3G auctions, access to gas transmission infrastructure, provision of rail services, treasury bond auctions and procurement auctions. These case studies prove fascinating reading from an auction design perspective, but also highlight many other factors that influence the success or failure of allocation processes more generally.

The case studies highlight many of the design and implementation issues that public administrators need to be aware of when implementing any allocation process. Although the case studies reinforce many of the messages that are highlighted in the earlier theoretical sections of the book they also bring to light many of the more

practical issues that are confronted when public resources are allocated between interested firms.

Chapters 6 and 7 contain an illuminating comparison of the many alternative methods of allocating spectrum licences needed by mobile phone companies. These include the beauty contest, fixed prize auction and variable prize auction approaches used in the USA and Europe. These case studies highlight the problem of designing auctions that involve asset aggregation problems and the examples included have clearly been selected to illustrate the different approaches that have been adopted. In some auctions, government has assumed responsibility for defining the bundles of spectrum offered, that is, bureaucrats have determined the scale and scope of licences needed to operate a 'viable' phone business. Other case studies describe auctions that have been specifically designed to allow bidders to assemble packages of spectrum that meet their individual needs. These studies illustrate the far-reaching consequences that different property right structures can have on relevant sectors and implications for the design of property rights and allocation mechanisms.

Chapter 8 provides an account of the process used to allocate gas transmission access in the UK. This provides an interesting insight to a class of problems where natural monopolies exist. Although the auction format used in this situation is of interest from a theoretical perspective – it involves a concurrent, sequential approach with multiunit demands – there are equally interesting issues associated with the definition of property rights and control structures that deserve attention from a policy design perspective.

Other chapters of the book provide case studies dealing with more unusual applications of auctions including that of matching markets. This class of problem has received considerable attention in the mechanism design literature from Milgrom and other economists.

The book offers many insights into specific auction design problems, however, it is also possible to draw many general lessons, which become apparent upon consideration of both parts of the book. Three of these are worthy of further consideration. The first is that there is clearly more to auction design than the choice of auction format. Many of the pre-auction and post-auction decisions that confront governments have significant implications including defining the objectives of the allocation process, specifying property rights and contract design. A second general observation is that each allocation problem is different and will need to be investigated separately. Finally, designing efficient allocation systems, particularly where multiple, interrelated-units are offered, will require input from specialised skills in economic theory, experimental economics, specialised knowledge about an industry or sector and specialised skills in political processes.

Overall the book forms an important resource for economists involved in designing allocation systems, particularly those relevant to public assets. It provides insights into the complexity of auction design and the need for specialist input from appropriately trained economists. However, the book should not be approached as a substitute for detailed training in auction design for which there is a large body of published literature. The only criticism of the book is that it does not provide a summary of either the theoretical or case study sections and would have benefited from a combined summation

of both sections. This aside, this is a book that can be read in sections and stands as an enduring reference source for those interested and involved in public sector resource allocation and procurement problems.

GARY STONEHAM
Economics and Policy Research Branch
Department of Primary Industries
Victoria

Agricultural Systems Models in Field Research and Technology Transfer, by Lajpat R. Ahuja, Liwang Ma and Terry A. Howell. Published by Lewis Publishers, a CRC Press Company, Boca Raton, FL, USA, 2002, pp. 357, ISBN 1 56670 563 0 (hdbk), $US139.95.

The development and use of biological and biophysical simulation models for agricultural R&D and policy evaluations have evolved over the last 40 years. This book presents the experiences of modellers through the stages of developing and adapting agricultural simulation models in contributing to field research, technology transfer and management decision-making. The editors are soil scientists and an agricultural engineer involved in the development and use of such models, who have brought together a group of contributors 'to present the state-of-science of applications of agricultural systems models, and tremendous benefits to be derived from the use of these computer models in agricultural research and technology transfer in the 21st Century'.

In chapter 1, the editors present a list of important issues that should be addressed to improve the models and their applications in the future. These are mainly technical (model testing, validation, databases, parameterisation, communication, coordination and evaluation, and filling knowledge gaps) and give the impression that the value of modelling is accepted in terms of end-uses. Authors in some individual chapters have also been concerned about farmer and industry acceptance of the use of such models. Perhaps it is an Australian thing, but the authors describing the GRAZPLAN family of decision support tools and the soil and crop-based simulator, APSIM, are among a smaller group that have taken additional steps to describe their strategies and developments to improve on-farm acceptance of the use of their models.

This book contains chapters on the approaches and experiences of groups developing simulation models and decision support tools in grazing management in Australia; management of water, nitrogen, herbicide and growth regulators in cotton and soybean crops; evaluating benefits of models in research and decision support by means of examples; and the use of decision support tools for improved management including key factors leading to better adoption and use of innovations. Also included are a comparison of the performance of corn and soybean models under water stress conditions in the USA; and Australian experiences using crop models to design better farming practices in semiarid dryland farming systems, and the evolution of APSIM including its application and design. Other chapters address the issue of spatial scales and scaling up of model results, and how spatial variability can be included in modelling. An

extension is a discussion of how topographic attributes affect soil properties and crop yields. A chapter deals with the issue of determining model parameters for different parts of the agricultural system and how these change with environmental stresses and management practices. An object-orientated modular modelling computer framework is discussed, which would enable future model developers to create and quickly update custom models from a library of modules in the computer. Finally, agricultural concerns and future research needs are presented.

The main advantages of simulation models in determining responses to experimental designs (management alternatives) and policy questions are that such models can overcome the 'tyranny of site and season' inherent in field trials; that they can be developed to represent an agricultural system, as defined in some way; and that they can be used to make predictions for locations and situations beyond their initial specification. Some models have also been developed to predict environmental or natural resource outcomes from alternative agricultural management, an increasingly important issue for farmers and natural resource managers. These models, therefore, can play a vital role in evaluating farm and natural resource management issues and policy questions with which economists can be involved.

An important question, which some of the book chapter authors address, is the value or relevance of these models given the considerable sums invested in their development. Some models have been used to answer policy questions (e.g., the Albanian Government's choice of purchasing fertilizer or importing wheat during a food shortage crisis following the collapse of the Soviet Union), while others have been assessed in terms of whether they have influenced on-farm decision-making in a substantial way (e.g., use of APSIM in crop decisions by farmers in semiarid areas of Australia). In the latter case, concern about the apparent lack of use by farmers has been observed to parallel the aspirations and experiences of operations researchers. The approach of some groups has been to actively involve farmers, agricultural consultants and field scientists in developing the models and decision support tools in the process of addressing relevant questions for farmers.

This book does not present evidence of input by agricultural economists into the process of evaluating farm management issues using such models. The index contains no references to 'economics' or 'profits'. But most models or decision support tools have a profit component whereby inputs and outputs are valued to allow a gross enterprise profit comparison of management alternatives. The issue of considering complexity versus uncertainty, in how such tools deal with the choices faced by decision-makers, does not seem to have been considered by many of the models or decision support tools. For some decisions the best management option is clear to the decision-maker and it is only in other cases that the decision is uncertain. Simulation models represent the complexity in the agricultural system, but other factors may also influence the decision in these cases. The concern of decision-makers with uncertainty relates to other factors in decision-making, which may be difficult to quantify or appear illogical (and which can be addressed using the 'soft systems' approach). The decision support tools developed from 'hard systems' are not able to adequately address these issues.

The incorporation of agronomic and biophysical responses with economic analysis is becoming increasingly important as agricultural land use decisions are evaluated

not only for private benefits but also for public (natural resource or environmental) outcomes. The development of simulation models to represent broader spatial scales, as documented in this book, is important for addressing the current focus on management of river catchments. Agricultural economists interested in using agricultural simulation models in their work will find this book valuable as a guide to the types of models available, and for descriptions of the major models including their structure, strengths and weaknesses.

ROBERT FARQUHARSON
NSW Department of Primary Industries, Tamworth

Benefit–Cost Analysis: Financial and Economic Appraisal Using Spreadsheets, by Harry Campbell and Richard Brown. Published by Cambridge University Press, Cambridge, UK, 2003, pp. x + 345, ISBN 0 521 52898 4 (pbk), $A69.95.

Benefit–cost analysis (BCA) is a widely accepted method of assessing the welfare implications of policy options in a number of fields. Although having strong theoretical underpinnings, one of the major challenges in promoting BCA is the complex nature of a comprehensive BCA study. This textbook partially addresses this difficulty through the provision of a primer for conducting a BCA using close integration of spreadsheet analysis with analytical principles. The book, which is aimed at 'people with a basic understanding of elementary economics who wish to learn how to conduct a social cost–benefit analysis', provides a well-paced guide to the development of a benefit–cost-based analysis.

The text is intended as the required text for a sequence of two courses in BCA; however, the authors indicate that the first six chapters could stand alone as the basis for a one semester unit. Students would need to be familiar with traditional introductory microeconomic concepts such as demand and supply analysis, marginal analysis and imperfect competition.

This book is divided into three sections. In Part 1, consisting of six chapters, the authors develop a template, based on spreadsheet analysis, which is recommended for use in conducting a social BCA. The aim of a social BCA is defined in the introduction as being to maximise the welfare of society in general. In Part 2, the authors introduce complications arising in BCA, covering topics such as price changes, incorporating risk, the cost of public funds and imperfections in foreign exchange markets. In Part 3, the authors discuss some of the broader issues of BCA such as income distribution (Chapter 11), valuation of non-marketed goods (Chapter 12) and economic impact analysis (Chapter 13). The topic for Chapter 14, writing the BCA report, provides a suitable conclusion for the book.

The development of the framework in the first part of the book is complemented by a detailed case study designed around the activities and plans of a foreign company seeking to locate in a less developed country. The case study uses some of the basic functions of a Microsoft Excel spreadsheet to calculate internal rates of return and net present values. The ability to conduct sensitivity analysis is also clearly explained. The

appendix to Chapter 5 extends the case study to provide an economic efficiency analysis with the application of shadow prices, while the appendix to Chapter 6 extends the analysis to referent group net benefits. The case study is clearly explained and provides a good example for students of the spreadsheet analysis. Amendments to the case study in Part 2 provide practical illustration of the issues discussed such as allowing for an increase in the skilled wage, shadow pricing foreign exchange and the incorporation of risk analysis.

It is evident from the careful development of the material that the book has evolved from the extensive teaching experience of the authors. Each chapter is supplemented by exercises and further reading as required of a comprehensive textbook and the authors indicate in the preface that the text will be supported by a link on the publisher's website, which will provide access to spreadsheets, problem solutions and Microsoft PowerPoint presentations. A strength of the book, if it is used in entirety, is the manner in which the economic theory is interspersed through the text more or less on a 'need-to-know' basis. This supports the practical emphasis of the text while ensuring exposure to the relevant theory is maintained. Hence, despite the authors' accurate claim that the unique feature of the book is the integration of spreadsheet analysis to BCA and the emphasis on practical application, the theoretical foundations have not been ignored. Although there are many books on BCA, this text provides a valuable addition particularly in that it is practical in emphasis and Australian. It clearly illustrates some of the developments in BCA since the publication of the previously published and well-respected Australian BCA text by Sinden and Thampapillai (1995). Given that this text was published nearly a decade ago, the spreadsheet approach provides a timely addition to the resources available for teaching BCA.

My main reservation with the text relates to the manner in which it may be used. If it is adopted for an introductory course, which only focuses on the first six chapters, the balance between practical technique and theoretical foundations may be distorted. For example, it is not until Chapter 7 that consumer and producer surplus are discussed in any detail, and until Chapter 12 that discussion of economic value is included. The authors acknowledge that discussion of important economic concepts has been deferred until later in the book and that this is a reversal of most previous BCA texts where the theory takes precedent. In an ideal world, students need both the theory and the practice and what comes first may be a mute point. However, it would be disappointing if students undertake a course in which they develop technical proficiency without complete knowledge and understanding of the important theoretical framework.

The bottom line is: would I use this book as the text for a benefit–cost analysis course? And the answer is yes – it is a comprehensive text, which provides flexibility for the degree of depth of a course to be varied depending on the experience of the student cohort, the time available and whether the course is undergraduate or postgraduate. It provides the foundation for a stimulating and worthwhile course for students from a number of disciplines.

HELEN SCARBOROUGH
Deakin University, Warrnambool

Reference

Sinden, J.A. and Thampapillai, D.J. (1995). *Introduction to Benefit–Cost Analysis*. Longman, Australia.

Putting Auction Theory to Work, by Paul Milgrom. Published by Cambridge University Press, Cambridge, UK, 2004, pp. xxi + 368, ISBN 052 1536723, £22.99.

Observers and practitioners of public policy research in Australia, particularly in the natural resource domain, will be aware of the growing interest in auctions for the allocation of scarce resources. The Victorian *BushTender* scheme for the procurement of biodiversity asset management on private land is perhaps one of the more well-known applications in Australia. The developing electronic water trade markets, for example, *watermove* in northern Victoria,[1] are most like the double auction institution first investigated by Vernon Smith and Charles Plott in the 1960s and 1970s.[2]

Milgrom's new book on auction design perhaps arrives on the practitioners' desk at an apt time, as governments' interest in the feasibility and design of economic incentives grows. Within the *National Action Plan for Salinity and Water Quality, the Market Based Instruments Program*,[3] a five million dollar Commonwealth program that seeks to increase Australia's capacity to use market-based instruments such as auctions, is one example that has received considerable attention recently. Upon reading the work, however, it soon becomes clear that the audience would be well served if they have attended at least an undergraduate game theory course and are skilled in reading (at least) the language of normal form games. The technical aspects of the book are aimed more at the graduate level and the academic researcher, requiring competent knowledge of strategic or extensive form games.

Despite the specialised skill set required for a complete reading of the text, practitioners without a solid training in game theory will still most definitely benefit from Milgrom's work. The book provides an excellent discussion of mechanism design theory. Mechanism design provides policy-makers with a framework for understanding how field conditions – called the initiating circumstances or environment,[4] the incentives created by the policy – called the institution,[5] and the policy outcomes (the final distribution of resources and payoffs across participants), interact with each other. Smith (1982), Plott (1999) and Roth (2004) also discuss this framework. Perhaps the most interesting question for policy designers is how do different institutions – auction designs – impact on realised outcomes across different environments? Design economics describes a 'model of behaviour'; how individuals and groups respond in

[1] www.watermove.com.au.

[2] See for example, Smith (1962), and Plott and Smith (1978).

[3] www.napswq.gov.au/mbi.

[4] The environment includes the number of people or groups (agents); their preferences and endowments; technological change possibilities and the information/knowledge structure.

[5] The institution refers to the auction type. The auction rules specify who can communicate with whom, what type of messages can be sent and how messages are exchanged. Further, given the set of messages sent how are resources allocated between agents?

each environment to requests for information and action by the institution. The model will predict different responses in different environments to the same institution as well as different responses in the same environment to different institutions (Ledyard 1995). This framework allows the designer to pose questions such as, how does a given institution perform, and does it perform optimally across different environments? Or, for a given environment, how do different institutions perform and which institution performs optimally? Policy outcomes are ranked according to performance criteria. Standard performance measures include the sum of gains realised as a percentage of maximum possible gains, as measured by consumer and producer surplus.

In the early parts of the text, Milgrom provides some famous examples of successful auction applications and the mechanism design issues behind the final auction design. Perhaps the most famous of these is the Federal Communication Commission's (FCC) Spectrum Auction in the USA. The FCC experience highlights a design problem often encountered in natural resource allocation: the contracts for goods are not independent as the value of one contract depends on the set of contracts a bidder wins. This interdependency can arise when goods are complements or substitutes. The complement and substitute issue is prevalent in natural resource management. The purchaser of biodiversity (often the government) may not view management contracts independently. For example, biodiversity corridors may be required, therefore, two bids on adjoining properties may have a higher value than the same two bids on geographically separate properties.

Landholders may also view bids dependently; for example, a landholder may value a set of mixed length contracts over different sites differently to a single length contract over one site. Irrigators engaged in a water and salinity market require both water and salinity contracts in order to produce. The value of a water contract to an irrigator depends on the cost of securing a salinity contract. Another example is the allocation of production zones for caged aquaculture. The value of one site depends on the location of other sites secured because of currents that supply food for the stock, and because the cost of harvesting stock from geographically dispersed sites is much higher. Independent auctions for goods with dependant values will be inefficient as buyers must guess the value of a contract whose value depends on the final bundle or combination won. Package auctions and combinatorial auctions can minimise the inefficiency introduced by compliments and subsidies. Milgrom spends considerable time addressing interdependencies, and his final chapter discusses the technical design behind package auctions and combinatorial bidding.

Policy designers should heed Milgrom's words of caution that a good understanding of applied theory can reduce the likelihood of making very costly policy mistakes. Milgrom provides a number of examples where designers have ignored the basics of auction theory. An example of a successful auction was the British Spectrum Auction discussed by Milgrom and described by Binmore and Klemperer (2002). This raised $A34 billion in revenue for the regulator. An earlier experience in New Zealand, however, resulted in an auction outcome that was inefficient. The New Zealand government selected a second price sealed bid auction that, due to the interdependencies (similar to the FCC package problem described above) between contracts, resulted in an inefficient allocation across bidders; prices paid were often much less than the winning

bidder's highest bid. In one case, the highest bid was $NZ7 million and the second bid was $NZ5000. The realised total revenue was $NZ36 million, much less than the projected $NZ250 million.

As mentioned above, the technical chapters of the book are aimed at the graduate audience, and it is likely that we will observe course work being built around Milgrom's book. The chapters are challenging at best and very difficult in parts. The book does, however, follow a clear and understandable progression through the large body of work by auction theorists to date. The technical aspects discuss many auction design principles in robust terms that policy designers should be familiar with; such as dominant strategies, the revenue equivalence theorem, entry and exit, multiple units and interdependent values to name a few.

The author spends some time describing mechanism design theory and setting up a general mechanism design model (this is where the reader first needs her game theory language), which is then used later to set up, describe and compare different auction designs in the technical chapters. The title of the book contains the word *Theory* so the reader maybe should not be disappointed to discover only a cursory discussion of experimental economics. Milgrom does mention some of the experimental work by Charles Plott behind the FCC auction design (Plott 1997) and the smart markets developed at Cal Tech for implementation of combinatorial auction processes. As a practitioner in policy design, and a PhD student in information and experimental economics, I was disappointed by the absence of a good discussion on the use of experiments in auction design. For readers interested in experimental economics, Roth (2004) provides a great discussion about how experimental economics complements mechanism design, and Cummings *et al.* (2001) discuss the use of experiments to illustrate complex processes and provide empirical data for policy analysis.

Milgrom's book provides the reader with the discipline behind auction design. Auctions when implemented in the field must be simple to allow agents to effectively participate in the processes, the design of auctions and the subtle relationships between design and outcomes are, however, far from simple. Milgrom arms his reader with knowledge at both levels, and therefore, successfully engages both a highly technical postgraduate and postdoctoral audience, while also providing practical information to policy designers.

CHARLOTTE DUKE
Victorian Department of Primary Industries and the University of Melbourne

References

Binmore, K. and Klemperer, P. (2002). The biggest auction ever: The sale of the British 3G telecom licences, *Economic Journal* 112, 74–96.

Cummings, R., McKee, M. and Taylor, L. (2001). To whisper in the ears of princes: Laboratory economic experiments and environmental policy, in Folmer, H., Gabel, H.L., Gerking, S. and Rose, A. (eds), *Frontiers of Environmental Economics*. Edward Elgar, Cheltenham, UK.

Ledyard, J. (1995). Public goods: A survey of experimental research, in Kagel, J. and Roth, A. (eds), *Handbook of Experimental Economics*. Princeton University Press, Princeton, NJ.

Plott, C. (1999). Policy and the use of laboratory experimental methodology in economics, in Luigi, L. (ed), *Uncertain Decisions Bridging Theory and Experiments*. Kluwer Academic Publishers, Boston, pp. 293–315.
Plott, C. (1997). Laboratory experimental testbeds: Application to the PCS auction, *Journal of Economics and Management Strategy* 6, 605–638.
Plott, C. and Smith, V. (1978). An experimental examination of two exchange institutions, *Review of Economic Studies* 45, 133–153.
Roth, A. (2004). The economist as engineer: Game theory, experimental economics and computation as tools of design economics, *Econometrica* 70, 1341–1378.
Smith, V. (1982). Microeconomic systems as an experimental science, *American Economic Review* 71, 923–955.
Smith, V. (1962). An experimental study of competitive market behaviour, *Journal of Political Economy* 120, 111–137.

Toward Safer Food: Perspectives on Risk and Priority Setting, edited by Sandra Hoffmann and Michael R. Taylor. Published by Resources for the Future, Washington, DC, 2005, pp. ix + 319, ISBN 1891853902 (pbk), $US32.95.

Because of highly publicised illness outbreaks, food safety emerged as a major US public health issue in the 1990s. Resources for the Future Press have released another high quality book looking at the issues surrounding food safety in the USA. This book is a response to two US National Academy of Sciences panel reports in 1998 and 2003 that called for a more integrated, risk-based food safety system. It represents a multidisciplinary effort to integrate knowledge about food safety risks into a system-wide risk analysis framework, with contributions from a wide range of experts in various fields. As such, it will prove useful to scientists, risk analysts, economists, regulators and policy analysts, in providing information on how to better define the priority-setting problem and how to use available resources to construct a risk analysis framework for improving food safety.

The volume consists of 15 main chapters, involving 32 contributors. It is broken down into four broad areas: Framing the design problem; Risks and resources to reduce them; Tools for risk-based assessment of food safety policy priorities; and Identifying lessons.

Sandra Hoffmann provides an overview of the volume and US federal policy governing food safety regulation in the last 20–30 years in Chapter 1. There was obviously some last minute reorganisation of the book into four broad areas instead of two, and unfortunately this change was not reflected in the chapter's overview. Chapter 2 discusses the history and current status of the large number of US federal government bodies that have control over food safety issues. It concludes that agencies' responsibilities considerably overlap. Individual food safety regulations, such as carcass-by-carcass inspection in slaughter plants, consume major components of food safety budgets, with value for money highly questionable. Other rules on pesticides and food additives also generate significant resource use, which means that overall a large portion of the total federal food safety budget is devoted to only a few food safety issues. Chapters 3 and 4 look at food safety issues of pathogens and chemicals, respectively. There are 28 major known food borne pathogens, and six categories of substances, or residue types.

Chapter 5 details the budget and effectiveness of current US regulatory organisations, and suggests that there are some considerable efficiency savings and reallocation decisions that could be made, again by eliminating carcass-by-carcass inspections. Chapter 6 continues with this theme by discussing how cost–benefit analysis can be used to measure some of the social costs associated with food safety. It suggests focusing on approaches that minimise regulatory costs, such as using incentive-based approaches rather than command and control approaches. Although incentive-based approaches are usually more efficient, a more comprehensive discussion of the benefits of standards versus incentive-based approaches would have been appropriate as it is likely that standards would be more economically efficient in several food safety situations.

A number of economists from US Department of Agriculture (USDA) focus on the consumer benefits to be gained from reducing food borne risks in Chapter 7. It establishes the extent of market failure in the food market, which is triggered by asymmetric or missing information, while emphasising that there is still considerable consumer and producer incentive to minimise food safety risks. However, it highlights the problem that many producers face when whole classes of products share a negative food characteristic. The authors suggest that private food producers may face difficulties advertising superior food safety qualities with a slogan such as '7% fewer rat hairs than allowed by FDA'. The chapter continues with a discussion of the various approaches to valuing benefits such as cost-of-illness; willingness-to-pay; and quality-adjusted life years (QALY).

Chapter 8 summarises the state of the art of chemical and microbial risk assessment, with a detailed study of listeriosis. Chapter 9 looks at the usefulness of current priority-setting models. It argues that instead of ranking risks, agencies should rank risk reduction opportunities, applying a solutions-based approach instead. Chapter 10 discusses the Carnegie Mellon approach to risk ranking, which involves elicitation of multi-attribute risk preferences from lay groups. Chapter 11 further discusses the concept and usefulness of QALY, emphasising the need for further research to assign QALY losses to food borne risks. Chapter 12, written by James Hammitt from the Harvard Center for Risk Analysis, is probably the most useful chapter for economists in the book. It presents a detailed discussion of the factors that influence willingness-to-pay measures of food safety regulatory benefits.

Chapter 13 suggests ways that risk reduction policy can be improved. Chapter 14 also discusses opportunities for risk reduction, from an economist's perspective. It highlights that there are many potential benefits that can be derived from safer food, including higher consumer confidence, trade benefits and links between food safety and improved nutrition. The chapter emphasises the need for overall management of the entire risk portfolio – treating both microbial and chemical areas together. Without amalgamation, there is real potential that new risks will be ignored until it is too late. This chapter could have been improved with some discussion on the new potential risks created by agricultural genetic engineering. Although many scientists are in agreement that it presents no new risks to food safety, a number of scientists strongly disagree with this view and believe biotechnology will bring new challenges

to how the food market is regulated. An example of how scientists can underestimate risks is given by bovine spongiform encephalopathy, where there was no scientific reason why prion disease would jump species barriers, but it did. Indeed, there is very little discussion about biotechnology issues in the whole book, which is most likely a response to the proliferation of other books that bind the issues of 'food safety' and 'genetic modification' together.

Chapter 15, by Michael Taylor, concludes the book by describing food safety risk management models that are needed: risk ranking models, models of the effectiveness of current and proposed interventions, and resource allocation models that integrate costs, benefits and risks.

One of the main weaknesses of the book is the lack of clarity about what is meant by food safety and risk. To some extent, the book skirts the whole issue, and given the difficulty and complexity in defining food safety, this is not surprising. However, readability would have been much improved with an introductory chapter discussing all the issues surrounding food safety definitions and, as Caswell comments in chapter 14, the 'boundary issues'. For example, what is food safety? Chapters 4, 10 and 13 start to address the question, though none really get to the crux of the issue. Clearer discussion about food infections, food diseases and their causation factors would have been useful. Also, to what extent should food safety regulators consider concerns such as rising infertility and behavioural problems – both of which, critics suggest, can be directly attributed to synthetic chemicals? Should food safety be concerned only with the consumption of food, or should it be concerned with the production of food? Does it include the consumption of water? Considering an even wider definition of food safety would involve analysing nutritional factors. Although a few authors in the book did mention the issue of nutrition, none referred to the startling fact that overall, the level of minerals and vitamins in food has fallen considerably over the past 30 years. UK research has shown that fruit have lost on average 20 per cent of mineral density and vegetables 40 per cent, with some minerals reduced by up to 89 per cent (Mayer 1997). USDA reports tell a similar story. If nutrition is a food safety issue, then given the importance of diet and nutrition in promoting healthy living, reducing infections, reducing disease and the possibility of becoming ill from food borne risks, then the benefits of addressing nutritional issues would be large. Therefore, any risk-management strategies that are based on valuing risks and effectiveness of actions across a broad definition of food safety would most likely result in a reallocation of funds towards nutritional issues.

Overall, *Toward Safer Food: Perspectives on Risk and Priority Setting* is a valuable and contemporary new book on food safety, with many of the issues raised for the USA applying to other developed countries. Although the structure could have been improved with some reorganisation and additional discussion, it will be a worthy addition to the libraries of those working in food safety decision-making.

SARAH WHEELER
Centre for Market Regulation and Analysis
University of South Australia

Reference

Mayer, A. (1997). Historical changes in the mineral content of fruits and vegetables, *British Food Journal* 96, 207–211.

Agricultural Biotechnology and Transatlantic Trade: Regulatory Barriers to GM Crops, by Grant E. Isaac. Published by CABI, Wallingford, UK, 2002, pp. xii + 303, ISBN 0 85199 580 2, $US90.00.

This book is a timely publication raising important issues, especially for countries like Australia and New Zealand, regarding non-traditional barriers to trade. Although the subject matter concentrates on issues of genetic modification (GM), the book has wider implications and messages about barriers to trade in general.

The author aims to show how different attitudes towards GM technology in North America and the EU are reflected in their respective laws and regulations. The book centres on the non-tariff-barrier nature of GM regulation and classes these as social barriers to trade.

Chapter 1 defines the types of regulation and categorises these according to the social or economic rationale behind their implementation. Thus, non-tariff barriers tend to be classed as social whereas quantifiable regulations are called economic. As the author recognises, this is a simplistic classification but does have its uses. However, I am not sure Australians or New Zealanders would like food safety laws to be called social regulations rather than economic regulations given the laws are vital to these countries to protect the economic performance of their agricultural industries and have not been introduced just on the basis of internal social values!

Chapter 2 gives a good review of current biotechnology, identifying different types and clarifying some of the confusion around this technology. Three distinctions are made. These are crops with production traits, output traits and bioengineered products. These distinctions are useful but not really followed up in further chapters. There are four distinctions made regarding consumer acceptance of biotechnology. The chapter also explains why GM technology is a credence good. The problems associated with this are illustrated through the different acceptance of the technology in the EU and the USA.

Chapter 3 is called 'Economic interest in biotechnology' and attempts to cover the regulatory framework and economic background. The first part of Chapter 3 involves assessment of the structure of the GM industry and how this has evolved. The development of vertically integrated companies from research through to the production and marketing of the technology is argued as being consistent with the theory and rationale for capturing the benefits of GM technology. Although this is an interesting review of the industry structure, it does not seem of major relevance to the main theme of the book. The author then goes on in chapter 3 to describe regulatory interventions such as the Sanitary and Phytosanitary (SPS), Technical Barriers to Trade (TBT), Codex, and Intergovernmental Panel on Climate Change (IPCC) and Multilateral Environmental Agreements (MEAS). This is a useful review and helps to frame the international regulatory context in which countries can negotiate or protect access, in general or specifically in relation to GM technologies.

Chapter 4 focuses on the social interest in biotechnology and social regulatory development. The author argues that social interest groups are important. These are grouped into consumer, environmental and social development non-government organisations. This grouping does seem to ignore the government social bodies and organisations such as the UNEP (United Nations Environment Program) and the ILO (International Labor Organization). It is argued that social interest groups are against the top–down approach of the economic interest groups. Moreover, it is argued that social interest groups have a different perspective on two principles, which are fundamental to economic interest groups. The first of these principles is that technology and innovation are fundamental to economic growth and social welfare. The second is that price is the main factor with which consumers are concerned, and that trade-offs are made between GM technologies and lower prices. Many economists would certainly disagree with this second principle (that prices are the main factor), a fact recognised further on in the chapter.

The chapter also includes reference to the Cartagena Protocol on Biosafety as an example of an international agreement which incorporates a social perspective and yet one which could be used as the basis for trade rules. It is surprising that more is not made of this in the book. It is barely mentioned in the conclusion of this chapter, most of which is spent criticising the role of social interests in their reaction to GM technology with even a side swipe at the EU policy. This may be something with which many Australians and New Zealanders would agree but it did seem out of context here.

Chapter 5 is the central chapter to the book, focused on developing a Risk Assessment Framework (RAF) that could be used as the basis for regulation of GM technologies. The chapter highlights the two different approaches to an RAF, one based upon scientific rationality and the other based on social rationality. These two are often in conflict with the social rationality approach arguing that science cannot be divorced from its social context. The author also associates scientific rationality with an innocent till proven guilty approach to new technology and social rationality with a guilty until proven innocent approach. The author argues this leads inevitably to regulatory instability which organisations such as the WTO (World Trade Organization) are unable to deal with.

Chapters 6 and 7 then outline the US and EU regulatory framework to GM technology. These are thorough chapters, reviewing the development of regulations in these regions/countries. The conclusion is, not surprisingly, that the USA generally supports the scientific rationality approach, whereas the EU generally supports the social rationality approach, encompassing the precautionary principle. The author also argues that the EU regulations are unstable.

In Chapter 8, the author bravely attempts to combine these two approaches into the ideal regulatory framework. Although he lauds the social approach in recognising social concerns with the technology, he argues that this approach does not have a solid foundation and proponents are constantly reacting to perceived risk. This is discussed in the three identified components of risk analysis, which are risk assessment, risk management and risk communication. The author then argues that risk assessment must be based upon science, but that the questions it addresses should incorporate

normative ones. However, the framework excludes speculative risks, as these cannot be assessed through science. This may seem a bit naive seeing that many of the concerns regarding the technology which are currently influencing policy are based on untested hypotheses, something not just confined to the development of policy for GM technology.

The book, therefore, gives an interesting analysis of the types of GM regulation and their impact on trade. It highlights the differences between the sociocultural approach of the EU and economic focus of the USA. The EU's approach to agriculture incorporates the social aspect through multifunctionality and thus, achieves explicit social objectives, in contrast to the more productionist 'economic' approach of the USA. The consequences of this are divergence in their trade polices and conflicts within the WTO, according to the author. The example of GM technology is relevant to this argument, showing the importance of the precautionary principle to the EU against the more pro-technology approach of the USA.

The author argues that a risk-assessment approach which incorporates both the US and EU approaches would solve this dilemma. It would enable policy-makers and negotiators to include social and other factors but on a transparent basis. This is certainly laudable. However, concerns still occur, especially in relation to GM technology. The author is keen to point out that he regards as indisputable the benefits from GM technology. However, this is questionable. The benefits from the existing GM crops are certainly not without doubt, and the existence of crops/technology which provide attributes that consumers want seems a long way off (over 10 years away for most products) (Ministry for the Environment 2003). Therefore, to make sweeping statements regarding the benefits from these products is, perhaps, a little premature. Moreover, the author argues that while social criteria should be considered, risk analyses of GM technology should be based upon scientific evidence. The assessment of the risk of GM technology, however, is in its infancy and most researchers into, for example, the ecological impact of GM technology, argue that it will be a few years before reliable evidence becomes available. Thus, it could be argued that a main reason behind the reluctance of some to adopt the technology is the potential risk attached with its release. What the author suggests may recognise the risk but does not really propose anything that can alleviate it. For example, the author states in the last chapter:

> By addressing the credence nature of GM crops the polarity is minimised, resulting in informed consumerism based more appropriately on the actual benefits and risks, and fully in support of consumer choice. Given the enormous economic, human health and environmental benefits, it is difficult to believe that consumers, truly informed, would reject GM crops. (p. 266)

This contradicts earlier statements on page 53 that acceptance of the technology is positively related to education in the USA whereas the opposite is true in the EU.

Overall, the book is a useful addition to the literature on trade regulation and how it differs across different countries. It gives a good review of biotechnology and the development of this technology and offers interesting solutions on how to combine social and economic approaches to the assessment of technology. The book also gives

a review of non-tariff barriers based on the type of product and/or how it is produced. GM is a good example of a technology subject to this kind of trade restriction and the arguments in the book can be expanded to other issues such as beef produced with hormones.

CAROLINE SAUNDERS
Lincoln University, New Zealand

Reference

Ministry for the Environment (2003). *Economic risks and opportunities from the release of genetically modifies organisms in New Zealand*, Report to the Ministry and Environment and Treasury, Wellington, NZ.

Taken by Storm: The Troubled Science, Policy and Politics of Global Warming, by Christopher Essex and Ross McKitrick. Published by Key Porter, Toronto, Canada, 2002, pp. 320, ISBN 1 55263 212 1, $US19.95.

Essex and McKitrick argue in their book that a number of claims about global warming, including many made by the Intergovernmental Panel on Climate Change (IPCC), are wrong. David Pannell published a very positive review of this book (hereafter E & M) in this journal in mid-2004 (Volume 48, issue 2), but I was concerned with some of the assertions in his review. The editor and book review editor invited me to provide a second review, as I was much less impressed by E & M than David Pannell had been.

David Pannell repeats the assertion by E & M that a spatially-averaged temperature has no physical meaning (and so 'there is no scientific way to show' whether the world is becoming warmer). The assertion that a spatially-averaged temperature is meaningless would probably come as a shock to senior Victorians heading north in the belief that Queensland, on average, is warmer than Victoria. If they read this book, they would stay shivering through the Victorian winter, telling themselves that there is no physical basis for saying that, on average, Queensland is warmer than Victoria. E & M also argue that the temperature of a room can be just as validly represented by a thermometer in a glass of iced water in the room, as by any other temperature measured in the room. So, the next time you think your office is getting too warm, do not call the air conditioning repair person – simply shove a thermometer in a glass of ice water and convince yourself that your office is cool.

E & M argue that global temperature variations are unimportant by plotting a time series of mean global temperature on a graph with a vertical scale from about -273°C to about 27°C (they use the Kelvin scale in their figure 5.5, but the units have the same magnitude). Not surprisingly their figure shows the global temperature time series as a horizontal line, because the variations in global temperature are only of the order of a degree or two and do not show up on such a gross scale. This is analogous to plotting a time series of the Australian gross domestic product (GDP) for the past 10 years with a vertical scale of $A0–1 000 000 million. Such a procedure would produce a horizontal line with no apparent variations or trends, just like E & M's temperature graph – implying that any variations in GDP were too small to be important.

Other statements in E & M repeated by Professor Pannell are misleading. They contrast the different time series of mean temperatures calculated using surface measurements, balloon-borne instruments, satellites and proxy data such as tree-ring widths and assert that 'Only the averaged surface thermometers show a net increasing trend since 1940'. In fact, a credible global average from balloon-borne instruments is only available since 1960 because the network was too sparse before this (and since this time the network does exhibit warming similar to the surface measurements). And the satellite measurements are only available since 1979 (and these also exhibit warming, even over this shorter period). And there are several measures of surface temperatures (e.g., air temperatures over land, air temperatures over ocean and sea surface temperatures) and these all exhibit warming. All of these details are easily checked.

Another detail that is easily checked is the number of stations in a global network of surface temperature observations named the Global Historical Climatology Network (GHCN). In their figure 4.4, E & M show the number of stations in this network dropping from approximately 15 000 circa 1970 to less than 6000 by the year 2000. They say this is because 'two thirds of the weather stations in the GHCN network have closed in the past three decades'. Simple fact checking (type 'Global Historical Climatology Network GHCN' into your Internet search engine) will reveal that there never were '15 000' stations in the network (the peak number was about 6000), and that the decline in numbers is not because of station closures, but because it sometimes takes years to archive station data (and that the early data had already been archived many years ago). A bit more work would have shown that the decline in station numbers is not the cause of the observed global warming.

E & M and Pannell are critical of the IPCC. David Pannell states that 'The IPCC has been cavalier and misleading in exploiting adverse events to promote its agenda (e.g., attributing glacier melt in the Himalayas to global warming, and using this to promote CO_2 cutbacks, when in fact the trend of air temperature in the Himalayas has shown no warming)'. It is difficult to maintain meteorological stations in regions with high mountains for the period needed to determine trends, and so the maps in the IPCC reports do not calculate any trends for the Himalayas. However, there has been very strong warming across almost all of Eurasia. It is reasonable to conclude that there has been a warming trend affecting air temperatures in the Himalayas (despite the lack of data in the immediate area). The discussion of glaciers by E & M would also leave the reader with the mistaken impression that it is only the Himalayan glaciers that have been receding. In fact, the IPCC observes that there has been 'a widespread retreat of mountain glaciers in non-polar regions during the 20th century', that is, across all continents. In the absence of widespread warming this could only be caused by a substantial global decrease in precipitation (which we know has not occurred). The reality is that the widespread retreat of mountain glaciers supports the other observations that the world has been warming.

E & M assert that climate is unpredictable, partly because 'no climatologist has lived through repeated events in his or her field', and because we cannot perform experiments on the climate. Well, I have lived through more than 50 'repeated events', also known as the annual cycle, and I can predict (not with certainty, but with considerable confidence) that Melbourne next summer will be warmer than it was during last winter. I have also

lived through many El Nino events and know that these are generally associated with drier conditions across much of Australia. During my life, there have been several massive volcanic eruptions (e.g., Pinatubo) and we know that these tend to cause global temperature to cool. We do know quite a bit about the climate, and what causes it to vary (and models do quite a good job at these and other aspects of the climate) and even how to predict some aspects of it. We do know that the so-called greenhouse gases keep the Earth warmer than it would be in their absence, and that we are substantially increasing the atmospheric content of some of these gases – that is, we are conducting an experiment on the climate.

E & M assert that there is no 'theory' of climate. In fact, the basic theory for climate is Newtonian physics, based on well-known equations of conservation of momentum, mass and energy and the equation of state. The documented success of weather and climate models and in predicting and simulating climate features such as the annual cycle and historical climate changes lies in this theory of climate.

On one point, E & M and David Pannell are correct, namely that we should stop relying on quick summaries. Any reader who is interested in the facts on climate change should examine the voluminous, detailed, and critically reviewed assessments prepared by the IPCC. They would quickly see that there is nothing 'cavalier' about the IPCC. They might even agree with Sachs (2004) that the IPCC is a 'remarkable example' of mobilising expert analysis to inform policy-makers.

NEVILLE NICHOLLS
Bureau of Meteorology Research Centre
Melbourne

Reference

Sachs, J. (2004). Seeking a global solution, *Nature* 430, 725–726.

Disclosure: Neville Nicholls was a Convening Lead Author of the Second IPCC Assessment (1996) and is a Lead Author of the Fourth Assessment currently underway.

Reply to Nicholls

Neville Nicholls has responded to a review of *Taken by Storm* (TBS), but unfortunately he gets many of the arguments in the book itself backwards and we must take issue with some of his criticisms.

For example, he vigorously argues that temperature is a local property, as if we had not spent many pages trying to convince the reader of this very thing ourselves. There is a one-act play in TBS in which the main character, Professor Thermos, mischievously places a thermometer into a glass of ice water during a discussion about what 'room temperature' means, provoking a discussion about what a thermometer actually measures. It measures temperature where the thermometer is, and nowhere else.

Such an observation is so simple and elementary that the play quickly becomes comedy. But comedy or not, we are forced to dwell on this basic, indisputable property of thermometers because it is inconsistent with the idea of a single 'global' temperature for the Earth. Unfortunately, many in the climate field think that an average over many temperatures is itself a temperature. But it is not; it is a statistic. Matters would be otherwise if the Earth was in thermodynamic equilibrium, but it is not – far from it. If it were in thermodynamic equilibrium, nothing would be changing, including climate, and we would not be alive to discuss the matter.

Nicholls apparently agrees with us in objecting to temperature experienced at a distance. However, he is hardly in a position to do so as he also seems to accept the global temperature concept. Throughout TBS, we explain that 'global' quantities, like averages of temperature readings from another hemisphere, do not drive local thermodynamical processes. Of course cold weather in Victoria would not cause seniors in Queensland to shiver. But the idea of 'global temperature' flirts with just such a connection. In other words, the climate in Melbourne, viewed through this statistic, depends explicitly on remote temperatures in places like Toronto, that is, temperature at a distance.

To illustrate this distinction between local and global, TBS uses the example of an ice cube melting by a fire, when it's freezing winter weather outside. Along the same line, unless temperatures are always increasing everywhere (they are not), it makes no sense to talk about a local glacier melting due to 'global warming'. In the example we cite on page 150, the local temperature record in the neighbourhood of a retreating glacier did not show any meaningful upward trend, even though its retreat was being attributed to global warming. Glaciers do not need an upward temperature trend to retreat, and the retreat of any particular glacier is not caused by an upward trend in some global average.

Nonetheless, the point about 'mean temperature' not being a physical variable does not imply it can never convey information. For Canadians in February, the mean, and any other averaging rule for that matter, will yield a reasonable characterisation of the differences between a local Toronto temperature and a local Miami temperature, since the ranges of the temperature fields do not overlap. But this example does not validate the common usage, where comparisons are made between the Earth's temperature field in, say, 2004, and the same field in 1994. The fields for each date span the order of 100 K, but differences in averages are on a scale of 0.1 K, three orders of magnitude smaller.

Calling the 0.1 K 'warming' in the context of the relatively enormous increases and decreases in local temperatures over time has no meaning. It is simply meteorological mumbo jumbo. Such a value could only make sense if the physics prescribes a specific averaging rule. Otherwise some other equally valid rule can come up with, say, −0.1 K over the same data. But the physics does not tell us what averaging rule to use – there is not a single dynamical or thermodynamical equation of physics that takes 'global temperature anomaly' as an input. In terms of temperature, physical theories use local absolute temperature or local temperature gradients only. All of the arguments claiming a global temperature-statistic drives local climate processes are soundly based on heavy breathing and vigorous arm movements only, not physics.

Given the strong position TBS takes on the non-existence of a global temperature in climate change, on elementary physical grounds, it is peculiar that Nicholls attempts to engage us on whether this non-existent thing is increasing or not. For example, he claims that it is misleading for us to suggest only one kind of 'mean temperature' series shows a net increase since 1940. But our argument (Chapter 4) is that there is no reason to believe the different averages have to agree, as there is no true global temperature for them all to agree with. Two different statistics from two different averaging rules over the same data can show contradictory trends, as can different data subsets averaged with a single rule. This is a matter of mathematics not meteorology. But many people assume they must agree, and because they do not, much effort gets expended (see pp. 132–135) trying to make them look the same.

As for the number of temperature series in our Figure 4.4, Peterson and Vose (1997, p. 2841) state there are more than 30 000 raw series in the Global Historical Climatology Network (GHCN) database, but some are duplicates, some get averaged together, etc. The final count has about half that in the compilation we used, but the graph has the same shape either way (compare Peterson and Russel Figure 2 with our Figure 4.4). Along this line Nicholls again attempts to engage us on global temperature by asserting that 'the decline in station numbers is not the cause of the observed global warming.' Did we say it was? No. We said it demonstrates that the rules under which the global temperature statistic is produced are not constant over time, so this statistic cannot even be regarded as an index, much less a temperature. If we do not accept the physical meaning of the global statistic, why would we care whether it is going up or down?

That said, some highly simplistic climate models do use a single surface 'temperature' as an input. Some readers may jump to the conclusion that this temperature is just the average in question. Be assured that there is no known way to link such an input number to the averages discussed above through the laws of physics alone. Such models are simply cartoons, useful cartoons perhaps, but cartoons none the less.

The peril of not understanding the epistemological difference between theories and models is one of the major themes of TBS, especially of Chapter 3. Not understanding the difference makes it hard for people to distinguish between model results that merely look good and theories that are good. The pre-1960 view, espoused by Nicholls, that big computers and Newton's laws will suffice, was washed away in a scientific revolution that goes on today.

Chapter 3 explains in some detail why Newtonian physics, 'based on well-known equations of conservation of momentum, mass and energy and the equation of state,' is no theory for climate and why climate models are not trustworthy, for very fundamental reasons. To drive this point home it is worth quoting the famous apology of the late Sir James Lighthill (one of the greatest fluid dynamicists of the twentieth century), which he made in 1986 as a result of this revolution (Lighthill 1986):

> We are deeply conscious today that the enthusiasm of our forebears for the marvelous achievements of Newtonian mechanics led them to generalizations in this area of predictability which, indeed, we may have generally tended to believe before 1960, but which we now recognize as false. We collectively wish to apologize for having misled the general educated public by spreading ideas about the determinism of systems satisfying Newton's laws that, after 1960 were proved incorrect.

This view can certainly be found in the Intergovernmental Panel on Climate Change report (IPCC 2001), if you look past the summaries. Read section 14.2.2.2, page 774, column 2, second paragraph: 'In climate research and modeling, we should recognize that we are dealing with a coupled non-linear chaotic system, and therefore that long-term prediction of future climate states is not possible.'

Quite a contrast from the brash confidence widely attributed to the IPCC in forecasting climate change, is it not? In fact, it is virtually the opposite position to what people think the IPCC holds!

To claim that there is a 'theory for climate', given these things, stretches the term 'theory' beyond meaning.

There are many other obstacles – scientific and political – to developing our understanding of climate to anywhere near the level implied by the confident claims implicit in the IPCC Summaries. In *Taken By Storm* we have spelled many of them out, and had fun along the way.

CHRISTOPHER ESSEX
Associate Director, Program in Theoretical Physics, and Professor of Applied Mathematics
University of Western Ontario
London, Canada

ROSS McKITRICK
Associate Professor of Economics
University of Guelph
Guelph, Canada

References

Lighthill, J. (1986). The recently recognized failure of predictability in Newtonian dynamics, *Proceedings of the Royal Society of London* A 407, 35–50.

Peterson, T.C. and Vose, R.S. (1997). An overview of the global historical climatology network temperature database, *Bulletin of the American Meteorological Society* 78, 2837–2849.

Intergovernmental Panel on Climate Change – Working Group I (2001). *Climate Change 2001: The Scientific Basis*. Cambridge University Press, Cambridge.