Book Reveiw of *The Knowledge We Have Lost in Information: The History of Information in Modern Economics*, by Philip Mirowski and Edward Nik-Khah, 2017, Oxford University Press, 298 pages, index included.

 Philip Mirowski always makes an impact with his books, both on those who agree with him as well as those who disagree with him. I remember when his *Machine Dreams* first came out. I went through the book exhibit at the ASSA meetings right after that, curious to see that book. When I got to the Cambridge University Press stand, it turned out that there were no copies, although they had not been sold. Somebody had absconded with them. When I inquired, the people at the stand said, “It could be either someone who really likes what he says about them or somebody who really hates what he says about them.” His ability to stir controversy has not declined since, and this book does not look to change this record. It does have a coauthor, Mirowski’s former student, Edward Nik-Khah, and one can see some chapters having perhaps a more technical rather than cuttingly polemical air. But this book is predominantly another book in research program that is clearly Mirowski’s.

 Indeed, this book brings together several strands that Mirowski has pursued since at least 1989. This includes how intellectual developments in non-economics sciences have been introduced into economics (Mirowski, 1989), how developments in mathematics and computer science primarily serving the US military substantially changed economics (Mirowski, 2002), how the nature of markets have evolved as information systems (Mirowski, 2007), how the neoliberal vision emerging from the 1947 Mont Pelerin Society conference influenced postwar economics (Mirowski and Plehwe, 2009), and how these developments failed to deal with the financial crisis of 2007-09 and its aftermath (Mirowski, 2013). The unifying theme is how information economics has evolved, involving all these strands in a grand synthesis. This history sees this as integrating developments from outside economics with the influence of military and ideological needs eventually leading to a turning upside down of the field from a view of hyper rational and intelligent agents to one where agents can be stupid as markets are designed by economists to serve a variety of special interests from telecommunications companies to banks. The authors plot a path from a world of rationality and knowledge to one of artificial ignorance in which information can be completely manipulated.

 In Mirowski’s most important books, even as many may be upset with parts of his argument and serious flaws are found, the book ends up redefining how most economists think about the subject being covered, with this holding for both *More Heat than Light* (1989) and *Machine Dreams* (2002). With the strong help of his coauthor, Nik-Khah, I think that Mirowski has pulled it off again with this book: we shall not think about the history of the economics of information and its role as we did before this book, even if some parts of the argument can be questioned. The particular drawing together of various strands and putting them into a certain context is broadly convincing and original, even if some others have made stabs at this synthesis. This is an achievement and an important book.

 What the authors posit is a three stage process in the postwar history of the economics information, which involves both how information has been viewed and how agents perceive or understand information. While some of the links and arguments made are stretched, and some odd contradictions appear, the broad picture is reasonably convincing and deserves to be taken seriously. An important reason why this picture should be taken seriously is not just its reasonable convincingness, but that the authors also argue that what has come out of all this is not necessarily the best for our society, despite some substantial achievements arising from it all.

 Regarding how information is viewed, they argue that in the 1950s information was viewed as being a “thing,” with this view identified with Claude Shannon who applied entropy theory to it. Curiously they argue at one point that this was not really Shannon’s own view, but in effect a misinterpretation of his view, with Shannon himself warning early on that many misunderstood his ideas and read things into it them that were not there. But this view saw cognition as “irrelevant” as information was easily gained, with learning coming through the purchase of a commodity, communication the same as exchange, and this information accumulated over time in the past.

In the second stage information is seen as an “inductive index,” seen as drawn from mathematician David Blackwell’s emphasis on the nature of state spaces and repeated observations in a game theoretic context. Cognition depends on intuitive statistics and epistemic formal logic, learning depends on statistical inference with communication through signaling (as in the identification of types of agents in games), and the future is where information exists through expectations.

In the third stage information is symbolic computation, seen as deriving from Alan Turing (none of these founding figures were economists). Cognition occurs through “symbol manipulation;” learning is through “algorithm augmentation;” communication is through information transmission, and information is generated in “The Now.” These three stages form the vertical axis of a figure that appears in the book three times with minor variations.

On the other axis we have “Knowledge Role.” There are three forms: “Knowledge Matters” “Knowledge Inaccessible/Tacit,” and “Cognition Irrelevant.” This leads in the two dimensional space of this figure to three outcomes seen as developing over time. The first is the *Walrasian School* that combines information as a “Thing” with “Knowledge Matters.” Next out in the middle of the space is the *Bayes-Nash School* seen as combining information as “Blackwell induction” with “Knowledge Inaccessible/Tacit.” Finally in the upper right of the figure is the *Experimentalist School* seen as combining “Computation” with “Cognition irrelevant” (although there is no explanation of how “Cognition Irrelevant” moved from the “information as a thing” to the “information as computation” category, one of those loose contradictions). The central chapters of the book present the development of each of these schools in succession, arguably the core of the book, with more general discussion in the earlier chapters and application to special cases in later chapters.

The Walrasian School was led by “Cowlesmen,” people associated with the Cowles Commission, especially Jacob Marschak, Leonid Hurwicz, Kenneth Arrow, the now little-known Stanley Reiter, whom the authors make a good case for being much more important than now generally understood, and Herbert Simon. Just to muddy the waters a bit, several of these are seen as playing roles or at least foreshadowing the later emphases on game theory and experimental economics, including Marschak and Reiter. Arrow is seen as very important but never pinning down his view of what information is and appearing to lump it with knowledge, at one point or another advocating nearly every possible approach to information while elsewhere questioning it. Ultimately Hurwicz (1969) is seen as the most important of these, especially as his emphasis on incentive compatibility paves the way for mechanism design as developed by the main players in the next stage, the Bayes-Nash group. As it is, all of these encounter in various ways limits on how to deal with information within neoclassical economic theory.

Unsurprisingly, along with the influence of David Blackwell, another figure not well known among economists now, the Bayes-Nash School was heavily influenced by John Nash and even more so, John Harsanyi. He provides a superior out to the old “Moriarty problem” of a possible infinite regress as agents attempt to model their expectations of how they each model the others’ expectations of their modeling of their expectations, and so on and on, which von Neumann and Morgenstern had dealt with by positing mixed strategies (Koppl and Rosser, 2002). But considering learning situations Harsanyi got around the reappearance of this problem by positing types of agents, then also allowing for a probabilistic analysis that becomes Bayesian in its dynamic learning context. Also influential and ahead of the game was Vickrey’s famous auction solution, which helped set the stage for Hurwicz’s introduction of mechanism design, then followed up theoretically by Eric Maskin and Roger Myerson, with this developing into the formal business of setting up auctions of many sorts by Robert Wilson, Paul Milgrom, and others. This is where economists became the masters of markets, creating them out of the whole cloth of information economics using game theory.

The earliest of these government-established auctions developed in the late 1970s as a result of the deregulation of the airline industry, with auctions for landing rights. However, the largest scale such auctions would be for the FCC spectrum auctions, which got going in the mid-1990s. The authors spend the third-from-last chapter focusing on these and how they led to “corporate ratification of the Bayes-Nash approach,” with congressional legislation specifying that game theory should be used in setting up these auctions. They document how such figures as Milgrom played the game of setting up these auctions for substantial consulting fees successfully, and how they competed with each other in trying to show the superiority of their own special schemes, on which they would take out patents. An important part of these systems was to use game theory to attempt to thwart collusive behavior by bidders.

Given this apparent success and dominance, how did the subsequent Experimentalist School emerge? Well for starters it was around from the start of setting up auctions, with Charles Plott and some associates involved in the airline auctions of the late 1970s. But more important has been the realization that often agents do not play to Nash equilibria, which has undercut the Bayes-Nash program, making the players move to “piecemeal analysis,” that is, ad hockery. And part of the problem had to do with the nature of information itself, as one critic put it, “Auctions in environments with multidimenstional signals are often inefficient because of the impossibility of efficient aggregation of multidimensional information in a one-dimensional bid.” The experimentalists also posed alternative approaches such as clock auctions rather than English auctions or sealed bid auctions (Banks, et al., 2003).

The leaders of this school unsurprisingly have mostly been people closely associated with Vernon Smith or Charles Plott, including Stephen Rassenti, and Robert Bulfin, although also including the much separate Alvin Roth, whose systems for assigning medical residents and organs for transplanting have received much attention. While the authors do not make it too clear, their critique in the next-to-last chapter of market designers Ausubel and Crampton who were involved in setting up the TARP auctions during the financial crisis were essentially experimentalists with their advocacy of clock auctions. They are seen as setting up a system that favored banks, just as Milgrom and other Bayes-Nash operators set up spectrum auctions that ultimately played to telecom companies. Indeed, the book closes with a denunciation of these players using “epistemic privilege” to “skew markets in favor of specific actors.”

Another aspect of the experimentlalists brings us to an issue put off largely so far, but a central theme of the book, namely the role of F.A. Hayek in all this. The opening for this is the interest of Vernon Smith in particular in Hayek’s work, although it is not really clear that it is his work on information that interests Smith so much as his later work on spontaneously emerging orders. In any case, Mirowski and Nik-Khah posit Hayek as the ultimate force in all this who was influencing nearly all players, either as a role model or as a foil to be fought against or overcome. At least part of this story looks correct, but part of their argument has brought serious criticism.

Something that is almost certainly correct is that as much as anybody, Hayek is the real father of information economics, something widely accepted by many parties and the main basis for his receipt of the Nobel Prize, with his 1945 paper on information (Hayek, 1945) especially cited for that. They devote a chapter in the early part of the book to how Hayek’s ideas of tacit and dispersed information initially arose out of the socialist calculation debate, with Hayek arguing that central planners simply faced insurmountable information problems that only dispersed free markets could solve. The authors go further, emphasizing the supposedly important role of the initial 1947 meeting of the Mont Pelerin Society (MPS), attended not only by Hayek but such other Nobel Prize winners who dealt with information economics as George Stigler, Maurice Allais, Ronald Coase, and Gary Becker. While Vernon Smith did not attend that conference, his involvement with information issues from the period of the Walrasian School on to the present combined with an admiration of Hayek adds to the argument, with the attendance by Bayes-Nasher Eric Maskin at a recent conference organized at George Mason University by Smith to honor Hayek even further adding to the argument.

As for the foil aspect, the authors argue that most of the early Walrasians, including especially Hurwicz who studied under Hayek, but also Arrow, were old market socialists who sided with Lange and Lerner in the socialist calculation debate, and so were seeking to respond to Hayek’s challenge on information grounds with their efforts that eventually led to mechanism design. Figures such as Maskin and Myerson are seen as recognizing his influence on Hurwicz, and Maskin’s attendance at the conference honoring Hayek is seen as showing how these supposedly contrasting strands eventually effectively converged on each other.

This argument takes on a more polemical edge in relation to the MPS as “neoliberalism” is invoked as a central theme throughout all of this development of information economics. Even though in the end we have these artificially designed markets, they are markets, and the dominance of markets is established and emphasized as a result. Early in the book the authors assert that what formed the postwar theory of rational choice was the US military, the rise of the computer, and the neoliberal political and ideological doctrine, with this triumvirate bringing together the strands of Mirowski’s earlier work.

A critic of this use of Hayek is the editor of the Hayek papers, Bruce Caldwell (2017), who accepts the importance of Hayek’s 1945 paper and its influence on Hurwicz and others in this tale. But he then points out that Hayek not only criticized Hurwicz and Arrow, but also game theory, equilibrium theory, and competition theory. In a chapter early in the book on neoliberalism, Mirowski and nik-Khah present six supposed doctrines of neoliberalism, but Caldwell argues that many of them really are not, and in any case many were not accepted by Hayek or his later Austrian followers. Caldwell also argues that Hayek distinguished information and knowledge. At least some of these complaints seem justified.

One problem for anybody relying on invoking neoliberalism to criticize somebody is that this is a mushy term that has had multiple meanings over the years. In fact it can be legitimately applied to Hayek as indeed among the earliest uses of the term was to describe the views of Hayek and Milton Friedman at that initial MPS meeting in 1947, strongly pro-laissez faire and free markets, along with being anti-socialist and anti-communist. The ideology is strong. But then even at that conference another meaning was present, with the term also applied to attendee Walter Eucken, leader of the Ordo-Liberals in Germany. This group became the main developers of the postwar West German economic system with its “social market economy” (*sozialmarktwirtschaft*). They were for free markets, but they also supported generous welfare state social safety nets. Later in Washington this meaning resurfaced, with centrist Democrats being described as “neoliberals,” strongly supporting the Washington Consensus and free markets, but also for social safety nets and some other government programs. The term is fuzzy, and Caldwell scores points in criticizing their overuse of it in their analysis.

I note one other minor flaw. There is an unfortunate amount of sloppiness regarding citations and references, with some cited items not appearing in the references. For a book that is predominantly a work of history of economic thought drawing on a wide array of sources, it is unfortunate that this flaw is present, although it is not too serious.

Nevertheless, this is an impassioned and impressive effort. I think that their laying out of this three stage development of the history of information economics will probably come to be widely accepted, even if many will not agree with all of their arguments. It is perhaps worth closing on one of their larger themes: that information and knowledge are not identical, and that the ultimate goal is “Truth.” After pointing out Arrow’s apparent conflating of knowledge and information and his wide wandering about on what information is, they quote Kenneth Boulding instead as “a far better guide to these issues than Kenneth Arrow” (p. 38). I close with their quote from him (Boulding, 1968, p. 142), which shows what this book aspires to in its best moments.

“Knowledge, however, has a dimension which goes beyond that of mere information or improbability. This is a dimension of significance which is hard to reduce to quantitative forms. Two knowledge structures might be equally improbable but one might be much more significant than the other.”

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