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A methodological perspective on economic modelling and the global pandemic

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A question that recent research on the global pandemic raises is: how do the assumptions underlying epidemiological models and economic models differ? Epidemiological models we now know have become quite sophisticated (see Avery et al., 2020). Debate among economic methodologists regarding the nature of modeling has generated a considerable literature as well (Reiss, 2012; Hands, 2013). Yet these two literatures are largely non-communicating. Perhaps this is because economics has produced relatively little research on pandemics (though see Boianovsky and Erreygers, 2021). Yet it might still be asked, what might economic models be missing that epidemiological models capture? And might there be some sort of methodological bias in mainstream economics that plays a role in this? One way, then, one might begin to answer these questions is by identifying the main phenomenon in question, namely, in the case of the pandemic, a particular type of process, and ask what the nature of this type of process is. Then we may ask whether there is something about this type of phenomenon that places it out of bounds for current economic methodology. Thus, what sort of phenomenon is a pandemic?

The pandemic as a phenomenon: Contagion

A pandemic may be defined as "an epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting a large number of people" (Last, 2001). What is thus characteristic of a pandemic is the extensive spread of a disease through its transmission across large numbers of people through their contact and interaction with one another. Epidemiological models explain this using the concept of *contagion* – a concept not widely used in mainstream economic modelling. Methodologists might accordingly ask themselves, what is it about mainstream economic models that explains this difference, and how would economic models need to be reformulated to explain a pandemic in the way epidemiologists and other disciplines do using the concept of contagion?

Contagion is a social behavioral concept in the following sense. A contagion is generally understood as a transmission of something – a disease, a taste, norms, habits, a practice, etc. – which acquires an increased social significance in virtue of how it travels across people through their contact and interaction. The dynamic it involves, I suggest, can be described as a two-direction, two-level feedback system: people's contact and interaction affect their shared circumstances, changes in which feed back upon and affect their individual circumstances, changes in which feed back upon and affect the nature of their contact and interaction, changes in which again affect their shared circumstances, and so on and so on until or unless something

brings this all to a halt. The first level, the process level, involves people's contact and interaction; the second level, the shared circumstances or an aggregate outcome level involves the development of something – a pandemic in the case of a disease – over and above people's process level interaction that produces it.

The difference between a system modeled only in one-level, process-based terms and one modeled in two-direction, two-level feedback terms can be seen as the difference between a 'complicated' system and complex one (Rosser, 2021). To illustrate the latter, we can see how such a system has been modelled in connection with models of innovation adoption. Everett Rogers, trained in communications and sociology, influentially modelled innovation adoption as a process whereby for a given population a rise in the number of adopters of something (a new technology, a fashion, a norm, etc.) is followed by a declining number of remaining adopters until the innovation, which functions as the aggregate outcome, is standardized and ceases to be an 'innovation' (Rogers, 1962; 2003). Frank Bass, in the field of marketing, in one of the most highly cited management science papers, formalized and generalized Rogers' model in developing his normal distribution, Bass innovation diffusion curve (Bass, 1969; see Davis, 2019).

Applying this to the pandemic, whatever distribution pandemics exhibit, normal or otherwise, this diffusion dynamic can be used in herd immunity models to describe how a disease first becomes socially significant with a high incidence of infections when immunity in a community is low, then becomes less socially significant with a lower incidence of infections as immunity rises, and then ceases to be a pandemic and a socially significant public health problem when immunity becomes widespread. Moving, then, from the model to methodology, what can we take away from this?

Self-fulfilling prophecies

Robert Merton, the famous sociologist, described in an epistemologically interesting way how in cases such as those above a change in the status of a socially significant aggregate outcome produced by a process of interaction between agents can reverse what is believed to be true. His classic example is the bank run (Merton, 1948). A bank examiner mistakenly judges a bank to be insolvent; this causes depositors to withdraw their money from the bank; the bank then actually becomes insolvent. It was thus first false that the bank is insolvent, and then true that the bank is insolvent, on account of the interaction between the bank examiner and depositors.

The innovation diffusion and pandemic herd immunity cases are thus somewhat different. It is true there are innovations and pandemics, but that innovations are standardized and immunity may become widespread does not change this and make it false. In contrast, Merton's truth reversal case involves what is called a self-fulfilling prophecy, where a false statement becomes true by means of a social interaction process. (The opposite, a self-defeating prophecy is where a true statement becomes false through a social interaction process. A well-known case is the Y2K problem where 'computers will fail at the start of 2000' was true until people acted to prevent this and made it false.) In the language of performativity (Callon, 1998), then, the combination of the statement and social interaction 'performs' or produces its truth value.

Arguably, then, there is a similar self-fulfilling prophecy dynamic operating in some countries in the current global pandemic. Assume it is generally true that public health authorities can manage the disease in the sense of minimizing its spread (like it is true for Merton that originally the bank is actually solvent). Nonetheless, in some countries critics of these authorities (like the mistaken bank examiner) have argued, or prophesized, that those authorities will not be able to manage the disease. This has led some people in these countries to adopt risky health behaviors (like depositors withdrawing their money). As a result, in some countries public health authorities have indeed failed to manage the disease (like the bank actually becoming insolvent). What was true, that public health authorities could manage the disease, became false due to how criticism of public health authorities has affected social interaction.

Notice, then, that both Merton's financial example and this health one employ a particular kind of analysis of the social interaction process level, namely, one in which one agent (the bank examiner and public health authorities) has some special power to influence others' opinions. In effect, the social interaction process is asymmetric across agents with some agent(s) being in a position to interpret the situation at hand and thereby influence how others interpret it. (Another example might be central bank forward guidance.) Epistemically, the determination of truth resides with one agent who is in a position to 'perform' it for others.

This sort of analysis, however, is uncommon in economics. One reason is that economic agents are all assumed to have their own preferences and generally form their beliefs independently of one another. Consequently, they are not subject to others' influence, and contagion social interaction processes cannot generally occur. Contagion is thus not a widely used concept in economics. Interestingly, however, one recent economics research program, behavioral economics, has employed an analysis of this sort, and does so by departing from the assumption in standard economic modelling of agents' presumed independence.

Libertarian paternalism's self-fulfilling prophecy analysis

Behavioral economics' libertarian paternalism, then, effectively employs a self-fulfilling prophecy analysis in its explanation of the influence choice architects have on others' choices. Choice architects design and alter other agents' choice domains, and this sets off sequences of new – for example, healthy – choices and the possible emergence of 'new' tastes in a community. If what was originally true was that agents believed they preferred unhealthy choices, but their new healthy choices make them "better off, *as judged by themselv*es" (Thaler and Sunstein, 2008, p. 5; their emphasis), then what was previously true becomes false due to the special influence of choice architects.

If this sort of analysis is novel for economics, it is not in business and marketing studies. Libertarian paternalism, of course, assumes choice architects are concerned with agents' well-being and act to promote beneficial social goals. However, choice architects can also act in their own interest and promote their own goals at the expense of others. The decoy effect, or asymmetric dominance effect, is where consumers have a preference between two options that a seller can alter by introducing a third option (Huber *et al*., 1982; see Angner, 2012, pp. 38ff). (The consumer prefers *A* to *B*; the seller prefers *B* to *A*; the seller introduces *C* which is less

preferable for consumers to both *A* and *B*; when *C* is designed correctly, the consumer can be influenced to prefer *B* to *A*.)

Seller choice architects are only one instance of what is presumably the general case of powerful or influential agents being able to influence other agents' choices through how they act in social interaction with them – libertarian paternalism's other-regarding choice architects thus being a special case. What is it that keeps this sort of analysis from being regularly used in standard rational choice theory?

The departure from standard rational choice modelling this involves, then, lies in behavioral economics' characterization of choice as reference-dependent. Reference-dependence is inconsistent with the neoclassical rationality theory independence of irrelevant alternatives axiom (IIA) and expected utility's independence axiom (IA) that each rule out agents changing their choices when new options are introduced. In effect, though for whatever reason the context of choice is changed, people's choices will still not change. Thus, whereas on the standard view, choices is always reference-independent, or context-independent, for behavioral economics it is always reference- or context-dependent (Kahneman and Tversky, 1979). Context matters.

This tell us one reason why standard, rational choice economic modelling is not well-positioned to explain the pandemic. Two-level contagion models, such as the examples discussed above, are built around agents influencing one another. As libertarian paternalism and the decoy effect show, some agents can influence other agents if they succeed in altering the context of choice for the latter. Since this sort of influence is ruled out on the standard view of rational agents via the IIA and IA axioms, nothing can emerge in that analysis over and above agent interaction in the way of a socially significant aggregate outcome that might manifest itself in a truth or belief reversal. Context doesn't matter.

In effect, standard rationality models are 'flat' one-level models in which aggregate outcomes are essentially a benign reflection of the process level, as in microfoundations DSGE representative agent macroeconomic models and in ordinary microeconomic market analysis. What you see at the agent level is, scaled up, essentially what you get altogether, and any social level commentary or social significance interpretations fall outside the model – at least in core standard economics models. Thus, though methodologists might be interested in whether truth reversals occur in economic processes, the performativity idea, this issue is simply irrelevant to much standard thinking – or perhaps non-scientific according to its methods and modeling practices.

Some heterodox and non-standard modeling strategies

What exceptions to this thinking there exist in economics besides in behavioral economics tend to fall on economics' heterodox periphery or if explored in mainstream theory are treated as anomalous. An example of the former are post-Keynesian economics models that emphasize uncertainty, such as Minsky models that show how banks that supply credit to firms in good times can over-estimate firms' credit-worthiness, this can then influence firms to incur greater debt, and in a downturn firms then find themselves overextended. At the aggregate outcome level, the process level (asymmetric) interaction between banks (an authority like Merton's bank examiner) and firms can generate systemic financial instability – Minsky's financial instability hypothesis (Minsky, 1992).

One methodological implication of this, Dow (2021) comments, is that the mainstream commitment to mathematical modeling may itself prevent adequate explanation of complex systems because of the bias this involves toward producing deterministic representations of economic relationships. This in turn bars thinking about policies and institutional design that might address the possible effects of uncertainty in such systems. In effect, complex system feedback loops and uncertainty go hand-in-hand, but both are ruled out by the methodology of mainstream modeling. Further, since much heterodox economics is free of this bias, it contains significant opportunities for methodological advancement in economics.

Another example is how George Soros (2013) modeled boom-bust cycles in financial markets. Like J.M. Keynes's famous beauty contest (1936), traders form interdependent expectations about asset values that may drive up prices – the upswing phase of a cycle. Yet given the speculative and conventional nature of traders' bets, expectations are fragile and subject to abrupt reversals that drive down prices – the downswing of a cycle. Like Merton's analysis, what occurs at the aggregate level and at the individual interaction level reflexively act upon one another generating phase changes driven by belief reversals (Davis, 2020a).

It is interesting, then, to see how in rare cases mainstream theory approaches two-level types of analysis. One example, the information cascade literature, shows how fads and fashions result when information is limited and agents follow other agents' choices (e.g., Bikhchandani *et al*., 1992). Agents indeed interact, but since agents' preferences remain private, the extent to which there are second level aggregate outcome social effects like fads and fashions feeding back upon their interaction depends on the assumptions one makes about the nature of information. In contrast, contagion models transmit their effects at the deeper level of motivation.

Another example, from behavioral economics, investigates social preferences (e.g., Fehr and Schmidt, 1999). Agents who have other-regarding social preferences act differently from agents who do not, and this might be interpreted as a type of aggregate level social influence. But it is hard to see how this sort of analysis could ever mount to the level of a contagion dynamic because all agents are still utility maximizers ultimately independent of one another, and whether agents even have these types of social preferences is always seen to be an empirical question.

Methodologists' looking under the lamp-post problem

Let us try to take stock of all this from a methodological perspective. For many years now it has been argued that methodologists ought to concern themselves with describing and analyzing the phenomena that economics investigates rather than engage in normative theory appraisal in the spirit of Popper, Kuhn, and Lakatos (Backhouse *et al*., 1998; see Hands, 2019). A problem with this prescription is that it means methodologists need to work with phenomena largely as they are understood by economists. Thus, on the one hand, for a 'flat' one-level mathematical modelling practice in which aggregate outcomes are essentially a reflection of the process level, this not only tends to tie methodologists' analysis of the phenomena to process-level theorizations of the economy, but also to the particular understanding of process-level of interaction dominant in economics, namely, a market-centric theorizing that emphasizes arm's length, contact-less interaction between economic agents. On the other hand, phenomena that especially need to be conceptualized at the aggregate outcome level, such as characterized the 2008 financial crisis, characterize the current pandemic crisis, and confront us with climate change, are likely to get limited attention or fall beyond methodologists' scope of investigation.

These limitations do not apply to all the social sciences, epidemiologists, computational scientists, or to philosophers who study them. This arguably reflects economics' professional organization, including that it pushes heterodox and non-standard economics to its periphery. Whereas economics is organized in relatively hierarchical, core-periphery way with mainstream approaches strongly dominating research and training (see Heckman and Moktan, 2020), many other social sciences are organized in less hierarchical, more pluralistic or open way that supports greater research heterogeneity, puts weaker filters in place on recognizing new kinds of phenomena, and thus create a greater space for their philosophy of science examination. So, an important problem that methodologists face as philosophers of science is in their being primarily philosophers of economics. To the extent that economics is slow to incorporate new content, if dominant theories tend to be slow changing, methodologists are likely to be limited to explaining in a backward-looking way how economics manages old content.

The light under the lamp-post metaphor suggests that everything is dark beyond the reach of the light economics throws. But the metaphor breaks down if methodologists adopt a revised view of the phenomena. Rather than say the task they face is to describe and analyze, the task might be seen instead as prescribe and analyze. What phenomena should economics explain? Financial crisis? Inequality? Pandemics? Climate change? This begins with asking, where in economics are such things already being described and explained, where outside of economics are they being described and explained, and how might we look at the differences between them?

One of the reasons methodologists abandoned the normative theory appraisal approach is that its normativity was rejected. Perhaps one reason for this was that criticism of economics seemed to threaten a backlash with methodology being increasingly regarded as irrelevant in the economics profession. Accordingly, analyzing the phenomena as given by economics might make a contribution to economics, and this might improve methodology's standing. Yet curtailing judgment and limiting the scope of evaluation also threatens making methodology into a positivistic type of investigation, limited to offering conceptual nudges, and avoiding discussion of

methodological value judgments. Is there, then, a way of maintaining a focus on the phenomena and also a critical scrutiny of economics that analysis entails?

Briefly, a way to do this is to take the phenomena as given, not solely by economics, but as phenomena that science at large takes as given. For methodologists, doing this can change the nature of the analysis it produces. Analyzing the phenomena as economics sees them puts the emphasis on the consistency of their explanation with economics' own goals. Analyzing the phenomena as science may see them emphasizes the compatibility of economics' explanation of the phenomena with how they may be explained elsewhere in science, such as in epidemiology.

This alternative view of the phenomena that methodology investigates increases its scope of investigation and holds a potential for aligning it more closely with other disciplines and indeed other methods developed elsewhere in science. The field of methodology since its postwar re-emergence in the 1980s has become increasingly self-sustaining, while also structurally more complex over time (Davis, 2020b). Surely it can now also accommodate a more interdisciplinary future path of development, and increasingly incorporate more complex forms of modeling and analysis into its research as have been developed in other disciplines.

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