# The Performativity of Networks

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The "performativity thesis" is the claim that parts of contemporary economics and finance, when carried out into the world by professionals and popularizers, reformat and reorganize the phenomena they purport to describe, in ways that bring the world into line with theory. Practical technologies, calculative devices and portable algorithms give actors tools to implement particular models of action. I argue that social network analysis is performative in the same sense as the cases studied in this literature. Social network analysis and finance theory are similar in key aspects of their development and effects. For the case of economics, evidence for weaker versions of the performativity thesis in quite good, and the strong formulation is circumstantially supported. Network theory easily meets the evidential threshold for the weaker versions; I offer empirical examples that support the strong (or "Barnesian") formulation. Whether these parallels are a mark in favor of the thesis or a strike against it is an open question. I argue that the social network technologies and models now being "performed" build out systems of generalized reciprocity, connectivity, and commons-based production. This is in contrast both to an earlier network imagery that emphasized self-interest and entrepreneurial exploitation of structural opportunities, and to the model of action typically considered to be performed by economic technologies.

> The realities of social structure are more blurred. . . . One special case are the procedures of social research, which to an increasing extent are being built in as an accepted part of the validation and legitimation procedures in current American society, for better or worse. (White 1965, 10)

> Several stories might be, and are, told about eigenvectors. (Breiger 2000, 110)

Social network analysis, broadly construed, is performative in much the same theoretical sense, and, increasingly, on much the same empirical scale, as the economic and financial models examined by the increasingly influential "social studies of finance" (Callon 1998; MacKenzie and Millo 2003; MacKenzie 2006; Muniesa and Callon 2007). That is the main claim of this paper. I argue there are three principal reasons for believing it. First, the two cases are alike. Considered as intellectual and practical projects, the structure and trajectory of social network analysis and finance theory

show striking similarities in form. Second, the standard of proof is within reach. While the evidence for weak or moderate versions of the performativity thesis is quite good, its strongest formulations are only circumstantially supported by the best evidence we have at present. Thus, the case for a performative dimension to network theory has about the same level of empirical support—which is to say, pretty good—as that for economics. Whether we should interpret this as a mark in favor of the performativity thesis, or a strike against it, is an open question. Third, and more positively, the evidence is relatively new. Paradigmatic cases of the performativity of economics go back some decades, but the performative moment of network analysis is more recent and much less well-explored. I offer several examples.

Network concepts and images are by now central not just to the economic sociology of markets, but to theories of social exchange in general. The importance of network ties to market exchange is a core aspect of what, twenty-five years ago, was beginning to be called the new economic sociology (Granovetter 1985). We visualize the circulation of people and goods in society as flow in a dynamically evolving structure of network relations. As a disciplinary project, network theory has grown from a peripheral position in the early 1970s—or, more charitably, from its niche as a respected but specialized subfield—into a central project within contemporary sociology. Network theory has proliferated and diffused across the intellectual landscape over this period with great success. Its ability to cash out some of its most important theoretical concepts and images in formal methods and usable tools has been a vital part of this process. As in the case of theories of finance and their expression in financial markets, we see network theory and its analytical toolkit embedding and extending themselves in a range of settings. The growth of network theory within sociology, in other words, has been accompanied—and is perhaps by now overshadowed—by its practical embedding in the world at large.

A secondary claim of this paper is that *what* we are seeing "performed" in these settings is quite different from the model of economic action investigated by MacKenzie, Callon and others, and also quite different from an earlier (and quite successful) effort to evangelize the network gospel. An older public image of the importance of networks in exchange was highly instrumental. It emphasized the benefits of "networking" for individual careers, and the strategic advantage to managers of having well-structured networks with respect to their employees, their suppliers, or their competitors. Despite the success of network imagery as a vehicle for entrepreneurial success in competitive markets, the network technologies and models that are being implemented most widely (at least in the public arena) are those that emphasize network effects in their aspect as channels of generalized reciprocity, connectivity, and community-building. While these aspects are not inimical to profit opportunities, in this sense the performativity of networks trends against that of economics.

In what follows, I lay out the performativity thesis in more detail and assess the

parallels between the cases of finance and network theory, providing a series of examples for the latter case. I then return to the question of the usefulness of performativity as a concept.

## THE PERFORMATIVITY THESIS

Economic sociologists have recently been arguing about whether it makes sense to think of the discipline of economics as *performative*. Originally articulated by Callon (1998) and refined by MacKenzie and Millo (2003), and MacKenzie (2006), the *performativity thesis* is that economics produces a body of formal models and transportable techniques that, when carried out into the world by its professionals and popularizers, reformats and reorganizes the phenomena the models purport to describe. This is a suggestive idea, and one that admits of stronger and weaker interpretations. In its strongest form, the performative process brings the empirical phenomena into line with the original model. Of particular interest in this approach is the focus—inherited from science studies—on how performative projects are accomplished by way of practical technologies, reproducible models and portable algorithms. The success of economics is not just a matter of a particular conception of rationality serving as a ceremonial gloss on social action (Meyer and Rowan 1991); nor is it a simple instance of ideological indoctrination (Marwell and Ames 1981). Rather, tools implementing formal models of action—"calculative devices"—are put in the hands of social agents by the model-builders or their representatives. These devices act as "cognitive prostheses" that enable actors to accomplish calculative tasks previously beyond their reach, but which are required by the theoretical models. When incorporated into the everyday work of market agents, these devices allow real settings to better approximate the original models, and their assumptions. This is the "performative loop" in its most interesting, so-called "Barnesian" form.

Mark Granovetter argued that a social theory of markets should begin with a view of actors as embedded in an evolving structure of concrete social relations. From this perspective, neoclassical economics is fundamentally misconceived, either because "the fact that actors may have social relations with one another has been treated, if at all, as a frictional drag that impedes competitive markets," or because, when they are examined, models "invariably abstract away from the history of relations and their position with respect to other relations" (Granovetter 1985, 485–486).[1] The strong version of the performativity thesis, by contrast, is a kind of backhanded compliment from sociology to economics. Complimentary because it acknowledges the success

[1]He goes on to argue that Parsonian sociology failed for similar reasons, also ignoring concrete social relations in favor of "enduring structures of normative role prescriptions deriving from ultimate value orientations" (486).

of economics in prosecuting its claims to objective knowledge of the economy, but backhanded because it claims that this success is not what it seems. Economics turns out to create rather than discover its subject matter. This idea has a beguiling appeal to sociologists. If the story is right, then it seems that sociology, the politically and institutionally weaker field, wins out over economics in the end, like a canny David besting a lumbering Goliath. The natives' account—something like, "These models work because they are correct, or very good approximations to the truth"—is shown to be wrong, and the sociological account ends up encapsulating and explaining the success of the economic one.[2]

Or so one version of the story might go. The most careful and detailed study to date of the performativity of economic theory, Donald MacKenzie's *An Engine, Not a Camera* (MacKenzie 2006), takes a much more circumspect line. The book's subtitle is not "How Markets Perform Financial Models" but rather "How Financial Models Shape Markets." To *shape* is not to *create* or *determine*. MacKenzie frames the book by claiming his argument is quite different from an economic sociology built on the concept of embeddedness, but when making his case he is scrupulous in his handling of the data, and much more conservative in his claims. Much of the empirical detail of the book fits quite comfortably into a more conventional institutionalist account of entrepreneurs working hard to consolidate a new field of economic action, yielding a market populated by densely-networked actors with a lot of local knowledge about the the particular financial instruments they manage (Healy 2006).

Nevertheless, stronger versions of the Performativity Thesis are increasingly common. MacKenzie (2006, 18-19) distinguishes three kinds of performativity: "generic," "effective" and "Barnesian" (together with the latter's negative complement, "counterperformativity"). Generic performativity means the active use of some bit of theory not just by economists but also by economic agents, policy makers and the like. Effective performativity requires that the use of theory not just be window-dressing: it must "make a difference" in practice. Barnesian performativity (named for Barnes 1983, 1988) requires that the use of economics actively alter processes "in ways that bear on their conformity to the aspect of economics in question." That is, the model or theory must bring participants into line with its picture of the world. In that case the model helps

[2] This is a risky strategy. In his 1953 Marshall Lectures, Talcott Parsons argued that the "basic categories of economic theory …can be *derived* from the frame of reference, general concepts and variables of the general theory of special systems" and thus that "economic theory can be treated as a special case of the more general theory"—that is, of Parsons' AGIL scheme of social action (Parsons 1991, 22-3). He went on to argue that Keynes' *General Theory of Employment, Interest and Money* was "the *kind* of theory of the short-run equilibrium process of the economy that one would ask for on the hypothesis that the economy was a social system as I have outlined it" and so claimed "to have broadly substantiated the thesis that Keynes' *General Theory* is in fact a special case of the short-run equilibrium theory of social systems" (33-7). This claim was rather poorly received by his Cambridge audience: "I was told that when Talcott made his statement a member of the audience shouted 'Shit!'" (Homans 1984, 328).

make itself true, in the sense that before the its public appearance the system did not behave in accordance with the model's predictions, whereas subsequently it does. Naturally, it is also possible that a model might undermine the real-world viability of the process it describes. That would be a "counterperformative" effect.

MacKenzie argues that performativity can be thought of as part of "a more general phenomenon: the incorporation of economics into the infrastructures of markets." He examines four cases from the field of finance theory where ideas developed (mostly) by academics might have had performative effects on the structure and practice of financial markets. These are the Modigligani-Miller "irrelevance" propositions for capital theory; portfolio selection theory and the closely related Capital Asset Pricing Model (CAPM); random walk models and the efficient market hypothesis (EMH); and the Black-Scholes-Merton (BSM) formula for option pricing. Taken together, these ideas form the core of modern finance theory, and they contributed to a revolution in financial markets that began in the late 1960s. The cases are mixed in their support for the performativity thesis. The Modigliani-Miller propositions helped launch modern finance theory but did not have strong or immediate practical consequences. In retrospect, they could be seen as providing intellectual support for less negative attitudes towards debt-financing, and as foreshadowing somewhat the financialization of corporate governance which took place in the 1980s. The CAPM's effects were also ambiguous, as its operationalization presented practical problems and its results agreeed only fairly well with the data. The use of the model in practice did not improve its fit with the data. The EMH's effects were more direct. It allowed researchers and investors to systematically identify market anomalies. Using the CAPM as a baseline, a series of studies investigated the existence of investment opportunities that offered excess risk-adjusted returns.

Finally, there are the BSM equations for option pricing. This is one of finance theory's crown jewels and also MacKenzie's best case for performativity. If the EMH provided an overall vision of how the market should work, then Black, Scholes and Merton provided a technique that could be put to work within the market itself. Here MacKenzie sees Barnesian performativity in action, because, he seeks to show, the method that traders used to identify the discrepancies in option prices was the same, in essence, as the one academic researchers used to assess the accuracy of the model itself.

MacKenzie refuses to oversell his findings, and is very reluctant to say that he has found more than strongly circumstantial evidence that his cases are performative in the strongest sense, where the use of a model in practice actively alters how things work "in ways that bear on their conformity to the aspect of economics in question" (MacKenzie 2006, 18). He does believe that some nontrivial version of the performativity thesis is true. But he only rarely speaks as though it has been empirically demonstrated, saying that "Black-Scholes-Merton option-pricing theory was enacted at the Chicago Board Options Exchange," or remarking that "what is now performed in Chicago is no longer

classic option-pricing theory" (MacKenzie 2006, 179, 202). Much more often, he says that "there will often be an element of conjecture" to such claims, or that there is "a lack of conclusive evidence" in crucial cases, or that the sociological processes "cannot be distinguished" from the strictly economic ones, or that "there is no way of being certain" that the practical adoption of theoretical models led to and improvement in the observed fit of those models (18, 194, 237, 256).

In considering these claims, economic sociologists have been variously supportive or skeptical. But they have confined themselves to case studies of economic expertise and its effects on the world. Debate has centered on the proper way to characterize economics and economists, and a three-sided debate has developed between Performativists, Virtualists, and Granovetterians (Carrier and Miller 1998; Miller 2002; Callon 2007; Finch 2007). There are several case studies across different economic sectors or in different national settings. But the idea that a social science discipline other than economics might have performative effects has not yet surfaced as a problem within the debate in economic sociology.[3] Sociologists have remained outside the performative bubble, hoping to pop it.

To the contrary, I argue that in its organization, content and effects, a current wave of social-organizational innovation is being built out of network metaphors and with network tools, and that it satisfies the criteria for "performativity" at least as strongly as is documented in existing case studies of economic models and their effects. Network analysis has a very high degree of "performative potential" because of its combination of a strong theoretical framework, its portable toolkit of methods, and its ability to be embedded in the architecture of exchange systems. As it happens—probably not by coincidence—its developmental trajectory is also similar in key respects to the main exemplar of performativity in markets, finance theory.

The parallels to the performative processes described by MacKenzie, Callon and others are direct and robust. Like the early days of finance as a discipline, network theorists begin in small numbers, languish in relative obscurity and have to wait before the force of their work is widely recognized. Like the intellectual products of finance theory, network researchers develop models notable initially for their relatively high degree of abstraction, their commitment to mathematical formalization under strong assumptions, and a combination of intuitively plausible force and lack of validation by any substantial body of data. As time passes, things improve in both camps. Like the early intellectual missionaries of finance theory, network theory begins to find a home in business schools, and versions of bits of it come to be propagated by consultants.

[3] This is not the case in other fields where performativity is a live issue. Most notably, at the intersection of gender studies, literary theory and postcolonial theory, a fusion of Austinian philosophy of language and Foucauldian theories of power underpin a well-established debate on performativity and its scope (following Butler 1990). I shall not discuss that very large literature here.

Eventually, I argue, in both cases the theory begins to have significant effects on the kind of processes it nominally seeks to describe.

## THE GROWTH OF NETWORK ANALYSIS

A detailed intellectual history of social network analysis remains to be written. Crudely, we can say that throughout the twentieth century a number of researchers and small working groups developed methods and ideas that, in retrospect, are precursors of contemporary approaches. But these groups tended not to reproduce or institutionalize themselves, and neither did they develop into a full-fledged field. One of the few histories of the field describes much of the twentieth century as the "dark ages" of network analysis (Freeman 2004). The intellectual consolidation of network analysis as a self-conscious enterprise began in earnest in the early 1970s as a recognizable theory group established itself (Mullins 1973; Leinhardt 1977; Holland and Leindhardt 1979). Harrison White's research group at Harvard was an epicenter of innovation, with other important work being done at Irvine, Chicago and also in the Carolinas. Network theory's diffusion as a practical technology followed on a decade or so after. Network researchers became increasingly familiar in sociology departments and, importantly, in business schools. The presence of network analysis in these settings was accompanied, more or less simultaneously, by "network entrepreneurs" who developed products to sell to firms, and consulting practices to convey them. Often these were the same people who were teaching in the business schools.[4]

Within academic sociology, specialists in theory (itself a formerly high-status specialization in occupational decline during this period — see Lamont (2004) on this point) gradually came to recognize network analysis as a serious contender in the space of general social theory, rather than, as had previously been the case, a more narrowly middle-range and primarily methodological enterprise. The appearance of *Identity and Control* (White 1992) helped consolidate this process, as it provided a distinctive theoretical statement encapsulating one of the central lines of work of the previous two decades. Papers such as Emirbayer and Goodwin (1994) and Emirbayer (1997) are indicative of this shift. The resurgence of economic sociology was another important aspect of the process. In its early days, the new field was more or less an alliance of network structuralists and organizational institutionalists. Many of its foundational statements and research exemplars are built up from network foundations. The field still bears the marks of its birth, with the network analysis of firms in markets remaining at the core of research activity (Convert and Heilbron 2005; Fourcade 2007).

[4] Recall the first chapter of *Structural Holes*, where Ronald Burt opens with the image of himself and a colleague explaining the network structure of a firm to its CEO and senior staff: "Panoramic view. State-of-the-art audiovisual. Nice chairs" (Burt 1992, 1).

The consolidation of network analysis within the academy and initial diffusion into the economy in the guise of firm-level consulting or managerial advising, while important, still leaves a gap between strong forms of performativity in economics, and the network case. Surely the sheer scale of the financial instruments and asset positions that might be in part "performed" by financial models have no counterpart in the world of social network analysis. Where is the equivalent of the Chicago Board of Exchange? Or Long Term Capital Management? Or Salomon Brothers? While the analogy works in principle, one might object, there is simply no comparison in scale.

The point is not without force. The institution-building resources at the disposal of the pioneers in financial modeling were quite substantial, as MacKenzie documents, and considerably larger than those available to their counterparts in network analysis. But it is important to properly situate the relative timing of each field's performative moment, and once we do so the comparison does not seem so implausible. Finance theory got off the ground quite slowly, beginning in the 1950s and was mostly in place by the late 1960s. It began to make its way into market settings in the 1970s—not without resistance from established interests—and by the late 1980s was in a very strong position. Network theory really gets moving perhaps twenty years or so later. Despite many precursors and lone wolves in its intellectual history, consolidation was quite late in coming.[5] The tools of the approach began to make their way into the academic mainstream and the world of consulting in the mid to late 1980s, rather than (as in finance) in the late 1960s. And until the 1990s, their practical impact was largely still confined to the world of managerial advice and personal strategy.

The timing of the formation of a viable social network subfield remains to be fully explained. But, once the field began to develop, some of the resistance it encountered was due to the difficulties in making its approach tractable on its intended scale. The papers put out by White's research group, for example, were directly concerned in principle with the theory of large-scale social structure. They explicitly differentiated their approach from a previous generation of sociometric studies of small groups. They also were committed to developing formal tools—"satisfactory methods for aggregating networks among individuals" (White, Boorman, and Breiger 1976, 734)—that could be applied to real data. In triangulating these goals, a consequence was that their analytical breakthroughs far outran the computational resources available to apply them. They were also constrained by the limited availability of data in appropriate form. The theoretical discussion in White, Boorman, and Breiger (1976) keeps the macro-structure of role systems for whole societies squarely in view, but four of the

[5] Again, this is quite similar to finance theory. Louis Bachelier's dissertation on the mathematics of Brownian motion and its relationship to the stock market languished in obscurity for decades before being rediscovered as its insights were being arrived at independently by others (Davis and Etheridge 2006).

five applications of the blockmodels developed in the paper have fewer than twenty five cases each.

White's group was well aware of this problem. Boorman and White (1976, 1441) argued that "[t]he present work tries to take seriously what Durkheim saw but his followers did not: that the organic solidarity of a social system rests not on the cognition of men but rather on the interlock and interaction of objectively definable social relationships." But, on the other hand, they acknowledged that their reach exceeded their (considerable) grasp: "We see at present no intelligent way to develop role interlock for open networks extending through large populations, even though this topic is much closer to the heart of sociology than is small-group structure." This problem may have contributed to resistance to network theory as a serious theoretical program. Sociologists outside the fold of network theory during that time might have been forgiven for wondering whether quite so much mathematical firepower needed to rain down on the heads of eighteen hapless monks, or whether the social habits of eighteen women really required elegant matrix operations in order to be satisfactorily described (Breiger 1974). To object on those grounds was to miss the point, but in an understandable way. As the availability of network data gradually increased, such objections became less and less tenable.

White's group and its descendants were by no means alone in facing this problem. Much the same problems of computational tractability and infeasible data collection faced two other streams of research in the incipient field. While the blockmodeling approach focused on the global structure of networks with the aim of providing role theory with new analytical foundations (and real tools for analysis), work on "small world" problems of pathways through networks (Sola Pool and Kochen 1978) — made famous by Milgram (1967) and descending from Rapoport (1953a, 1953b) — was in much the same position.[6] A third approach, built around metric methods (Davidson 1983) was better able to handle somewhat larger data sets, but rather than obtaining a complete picture of the network, ego-network information was used to generate multiple measures of social distance, to which the scaling methods were then applied to produce a few key dimensions of inferred structure (Laumann and Pappi 1973; Laumann and Pappi 1976; Laumann, Marsden, and Galaskiewicz 1977).

Network analysis developed and extended its methods and range of applications through the late 1970s and into the 1980s (see, e.g., Freeman, White, and Romney 1989; Marsden and Lin 1982; White 1981), and the macro-structural approach was pushed forward by work that connected network theory to other structural and ecological accounts of exchange, affiliation and stratification (Blau 1977; Breiger 1981; Cook 1982;

[6] White, Boorman, and Breiger (1976, 731) characterized the two approaches as the difference between an emphasis on the "knittedness" of multiplex ties in a network, and the "threads" or paths of connection through networks.

McPherson 1983). At the same time, though, formal organizations — especially corporations — increasingly became key sites for the development and application of network techniques, because more or less complete data on certain sorts of networks could be collected inside them.[7]

## THE PERFORMATIVITY OF NETWORKS

For a model to be properly performative, there must be something in the world for it to hook on to. A distinctive feature of economics is, as Foley (2002, 1) remarks, "that the very phenomena it studies take a quantitative form (market transactions, accounts) produced directly from the phenomena." Thus,

> The profit and loss of a company, or the net worth of a household, are quantities that are inherent in the existence of the company or household. The economist may have to take some trouble to collect and organize it, but is not required, like the physicist or biologist, to devise instruments to represent the phenomenon studied . . . in a quantitative form.

Economic sociologists might properly reply that a considerable amount of work needs to be done—and political conflicts resolved—before something like the accounts of a company are socially available in a way that seems to be "produced directly from the phenomena" (e.g., Carruthers and Espeland 1991; Espeland and Stevens 1998). It is nevertheless true that, as presently constituted, firms and other economic entities do yield such data as a matter of course. This provides the necessary substrate for a performative process to take hold. The same might be said of record-producing systems run by bureaucracies, and especially the state: they too can, under the right circumstances, generate formally analyzable data about their subjects as a matter of routine. Indeed, there is a close (and complex) connection between the development of the state's capacity to collect formal data, the specific form that data takes, and the growth and consolidation of economics and statistics as professions (Fourcade 2009; Schweber 2007). Until recently, no such data-generating substrate existed in most other social settings, of for many other kinds of interaction. This is now changing, as an increasing variety of social exchanges leave digital records in their wake. It is the increasing availability of widely distributed, high-volume, and above all more or less automatically-generated relational data that has enabled the transition from generic network imagery to more effective forms of performativity.

[7] Financial markets were also occasionally the subject of study (Baker 1984), but this was not so central a research topic. Baker's paper, notably, was published while its author was working for a consultancy firm.

The rapid development of computing power, the infrastructure of the Internet, and the protocols of the World Wide Web, together transformed the capacity to construct, visualize, analyze and build networked systems in practice. They were also accompanied by a big shift in the cultural salience of network imagery. The broad outlines of these developments were not unanticipated, but it is fair to say the system of connections that grew up over the course of the 1990s surprised most observers. Because its constituent elements were built up at different speeds, observers did have time to predict what was likely to be possible a few years ahead, and in some cases pursue the project of building out those possibilities themselves. The growth of the web was greeted with understandable excitement by social network analysts. Here was an amazing demonstration of the power of network effects, unfolding before everyone's eyes in real time, and on a very large scale. And here also, at last, was the potential to collect, visualize and analyze absolutely vast amounts of data on truly gigantic network structures. That potential had remained a distant possibility for a long time. Within the space of a few years, the size of actually-existing network data sets that were (in principle) accessible jumped several orders of magnitude. The upper limit went from perhaps a few hundred nodes to millions or tens of millions, as in the case of something like the centrally managed AOL instant messenger database or, more recently, the Facebook social graph. It is during this period that we can begin to see the performative potential of network analysis realized. I argue that *generic* and *effective* varieties of performativity are widespread. Barnesian performativity is more difficult to establish, but that is true for the finance case as well.

*Generic network imagery*

Computing power grew up first. It allowed for the accumulation of large databases and the potential to analyze the contents of this information, and also revealed the prospects for surveillance by those in control of information collection and storage. These implications began to be articulated in the 1970s. By the early 1980s, a series of well-publicized breaches of government and corporate computer systems by youthful hackers introduced the public to the idea that database systems were reachable over the phone, possibly by anyone. Commentators saw that the availability of data presented opportunities for new kinds of data analysis and that this would have broader social effects. A *Washington Post* article from 1984, for example, discusses the effects on privacy of "a world in which employers are monitoring workers" and "friends and neighbors are prying into one another's private affairs," especially "the young computer generation." Scott Boorman is quoted in the article, and his comments are of interest for the two dimensions of the issue he identifies. The first is the prospect of managers being able to identify "patterns of association between individuals" by way of electronic

records (Aplin-Brownlee 1984).[8] The connection to the business consulting wave of network analysis is clear enough, and in its way recalls the opening image of Burt (1992). The use of network tools in the consulting business has typically been rather less Orwellian (at least in retrospect) than envisaged here. Network methods are typically sold as tools to reveal the structure of a work group or organizational division to its own members, rather than just to upper management, and thus enhance productivity, creativity and effectiveness.

At around the time that network analysis was becoming more common as a consulting product, in the business literature network imagery and networking metaphors became increasingly prominent also. An early example of the genre is Welch (1980), *Networking: the Great New Way for Women to Get Ahead*. Other examples include Fields (1983), Youngs and Boe (1989), Raye-Johnson (1989), Krannich and Krannich (1989), Baber and Waymon (1992), and Fisher and Vilas (1992), amongst many others. Looking at these books from the 1980s onward, is striking to see how many of them are written by and for women. In the business paperback market, as distinct from corporate consulting, networking is often presented as a way for women to connect with the right people and succeed in business through taking advantage of their skills at interpersonal communication.

At this point, the idea of interpersonal networking in the business world was well-established. Similarly, people were aware that large electronic databases containing detailed personal information — including network information — were held in both public and private hands; and that this data might be accessible to enterprising hackers over the phone. But although the business side emphasized network imagery (connections, payoffs, brokerage, and so on), discussion on the computing side still tended to be framed in "information society" terms (Bell 1976) where the revolutionary potential of computers and information technology was acknowledged but its encapsulation and control by existing organizational and institutional forms tended to be questioned less.[9] Boorman's comments on this point in Aplin-Brownlee (1984) are of interest:

> "I would say that the concept of privacy is profoundly changing," Boorman said. "In the old days, 10 or 15 years ago, an invasion of privacy meant that someone had somehow gotten at some personal secret of yours and had revealed it to some third party or to the world at large." But large new data bases of "very mundane information" about individuals . . . make it "possible to characterize one's life history on an almost minute-to-minute

[8] Boorman described a hypothetical situation in which a manager is concerned that some of his "bright young engineers" who formerly worked together might be planning to quit and form a rival firm. "What kind of early-warning can one have for that kind of split-off?" Boorman asked. "That can be picked up by phone patterns [and] electronic mail ..."

[9] But see Bell (1980).

> basis" on and off the job and to use this information for "something much more interesting than ferreting out particular secrets. …I think this goes well beyond the immediate, classic problem of government agencies exceeding their statutory mandate …In a funny way the people we are most vulnerable to is our own immediate employer."

To be clear, a newspaper article is not the place to find a fully articulated view of this topic (Boorman's least of all). But the discussion represents a point when the social possibilities of networked information technologies were beginning to come into focus. They foreshadow a shift from a concern with the effects of "computers" as such to an emphasis on the connections between repositories of information, and beyond that to the prospect of detailed personal data being used in more interesting ways than just exposing secrets. The growth of data collection is acknowledged, and the implications for the concept of privacy are picked out sharply. But the social units involved are still the individual, the organization, and the state. Data repositories are seen as allowing for the *ex post* reconstruction of pre-existing social structure through formal analysis. The networked dimension *of the data itself* is conceived in much more limited terms as the problem of unauthorized users hacking their way into systems. What is missing is the idea of a network form of organization built out of the flow of quantified but "very mundane information" that might "characterize one's life history", and which might be actively constructed by users themselves rather than collected by some supervisory entity.

The core infrastructure of the Internet was already in place by the 1980s, though not especially widespread (Abbate 2000). The development of the WWW protocol and browsing software in the early 1990s gave people the basic tools to connect across it, and pushed its growth out beyond government and educational institutions. In the early days of the World Wide Web (before 1995-96 or so), the marvel was the sheer fact of connectivity, the ability to follow threads through a huge network, like a speeded-up version of Milgram's six-degrees letter experiment. The fact that a network of this sort even existed, was more or less freely navigable, contained a motley assortment of content made available by all manner of people and organizations, and which one could contribute to easily, was remarkable in itself. The dominant metaphors of the period emphasized the flow of information across the network ("the information superhighway") and its abstracted, slightly ethereal quality ("cyberspace"). The first wave of investment in dot-com startups, however, funded all manner of ill-advised efforts to get people to buy various products online or provided unwanted alternatives to things already available elsewhere.[10] Otherwise, few websites did anything useful. Retail sites were catalogs. The most widely-used navigational tools were catalogs, too,

[10] See Kaplan (2002) for a survey of failures from this era.

structured along the lines of the Yellow Pages (recall that Yahoo! was originally an acronym where the "h" stood for "hierarchical"), and early search engines did not perform well. Although the majority of websites were reachable from one another, and the existence of links between them made the network imagery more than just metaphor, the structure of the web had no semantic content built into itself. Prognosticators envisioned a world of much richer information flow and connection (Dyson 1997; Dertouzos 1997), but the web during its first boom period did not exemplify it.

*Data Generation and the rise of Affiliation Engines*

The more recent past, however, have seen the rise of a second wave of innovation and expansion. These are so-called "Web 2.0" technologies. The label originated as the name of a conference (O'Reilly 2005), and there has been some disagreement about whether it refers to anything more than the latest round of venture capital investment, although skeptics now tend to agree that even if the label is something of a misnomer it still refers to a real group of features.[11] The key innovation in these technologies is not the network infrastructure or basic protocols for data transmission—those are now taken for granted—but the ability to encode, extract and make useful much of the *semantic* content of data that was previously untapped. This has been characterized as a transition from "information silos" — networks of sites that are formally connected but substantively isolated — to "architectures of participation" that are much more interactive. Network imagery and concepts are once again to the fore, as they were during the 1990s expansion, but with a different emphasis.

Since about 2003 a plethora of new kinds of websites and services have appeared that make it much easier for users to assemble rich, multifaceted networks devoted to the cataloguing and exchange of all kinds of information. These sites typically embed various network techniques in their software service, and make an effort to reveal the structure of the network to users or otherwise harness structural properties in order to do something useful. The precise techniques vary, depending on what a site is for. As we shall see, these methods are closely related to one another.

**Aggregation and filtering** Pioneered by sites like Slashdot, Kuro5hin, and Metafilter the idea that the readership of a website could act as the site's own quality filter has been around for some time. Slashdot institutes a moderation system for comments on stories, other sides extend the idea to stories posted in the first place, with users

[11] "'Web 2.0' is a weird phrase. It began as the name of a conference, but the people organizing the conference didn't really know what they meant by it. Mostly they thought it sounded catchy. However, 'Web 2.0' has since taken on a meaning . . . It's kind of like they printed the name on a sticky label, threw it on the floor, and it stuck on the heel of a guy passing by. The name is a little fake, but the guy is real" (Graham 2006).

being allowed to vote on whether a story should be retained, highlighted or otherwise promoted. More recently, sites like Reddit have generalized the approach and combined it with the ability to record individual preferences. Reddit, for instance, uses its voting mechanism to control which stories are assigned to the front page, and each individual vote from a particular user also contributes to that user's personal filter for stories they would prefer to see.

**Rating and reputational methods** The principle of aggregation and rating of news items or comments is easily extended to the more general case of *collaborative filtering*. Here the preferences of individuals, expressed through choices and ratings about choices, are aggregated using a similarity metric and the goal is to predict whether and which users will like the next item that comes along. Thus, Amazon has long collected information on what its customers buy, asked them to rate what they buy on a five point scale, and then tried to make recommendations on the basis not just of the past behavior of consumers, but the behavior of putatively similar consumers. Collaborative filtering is a hard problem because it is focused on prediction of future likes and dislikes. Its strongest base at present is in computer science, specifically the field of machine learning. But its approach closely related to algebraic methods for the discovery of categories, where the goal is to cluster the individuals or items into subsets in order to make predictions. Where this area overlaps with marketing data the rewards to well-functioning systems can be large. For the past year, the DVD rental site Netflix has been running the "Netflix Challenge." Users are invite to register (for free) and download a dataset consisting of over 100 million distinct ratings of almost 18,000 film titles by just over 480,000 people. This is itself only a sample of Netflix's database of ratings, intended as a training dataset for the prediction algorithm. The rest of it is kept by the company. If they are not overfitted, algorithms to make good predictions out of the ratings should do well on the hidden data. The first entry to do ten percent better on the target data that Netflix's own algorithm (as measured by improvement in the root mean squared error of predictions) is promised a prize of a million dollars. As Tom Slee remarks, what is interesting here is that Netflix is "crowdsourcing" this problem by offering the prize, rather than trying to hire people to do it (Slee 2007). In its business Netflix relies on crowdsourcing (the aggregated choices of many users) rather than movie critics or experts in order to suggest new items to its users, and now it hopes to take the same approach to improving the former process.

**Tagging** Instead of rating items (out of five stars, for example), users may tag or classify them instead. Tagging systems allow users to associate labels with objects, such as webpages, photographs, book or article records, and so on. At the individual level the result is an informal classification system where categories usually emerge more

or less haphazardly over time, and in any event based on the needs of a particular user. When such systems allow users to see or search each other's tags, and objects can accumulate tags from many users, the result is a *folksonomy* (Wal 2007; Shirky 2004) — a structure defining classes that emerge from multiple instances of labeling. Tags make filing and searching easier, but the categories that arise are not intended to be exclusive or exhaustive in the sense typically reached for by hierarchical classification systems. Sites such as Del.icio.us and Flickr provide good examples. Folksonomies can be visualized in various ways, for instance in the form of a "tag cloud" that simply shows all tags for a user (or group of users) in alphabetical order with the font size of each label scaled by the frequency of that label's use. They also make it easy to see what is popular within certain categories at any given moment. As Shirky (2005) puts it, "Tags are important mainly for what they leave out. By forgoing formal classification, tags enable a huge amount of user-produced organizational value, at vanishingly small cost." And of course tags are easily thought of as generating a network that ties together the individuals tagging, the items tagged, and the labels items are given. This makes it possible to suggest items to readers based on their patterns of classification and the classifying work of similar others.

**Equivalence methods** Newer services put tags and reputational scores to use by using this data to make users aware of their similarity to others. A simple but effective example is LibraryThing, a service that allows people to catalogue their books. If this was all it did, its attraction would be somewhat limited. But it also allows users to tag their books, to see who else in the system owns the books they do, to see simple and weighted measures of the similarity of their library to others, to get predicted recommendations based on the recent acquisitions of the 50 libraries most similar to their own, and even to see which books are *dis*recommended. ("If you liked *The Logic of Practice* you certainly will not like *Tuesdays With Morrie*.") Once again, this is accomplished mostly by way of data voluntarily entered by users. (The core catalog information is obtained from libraries and online booksellers.) Users tag their books, adding metadata to the system. This allows for the creation of a dual-mode network of titles and individuals, augmented by classifications supplied by participants themselves, which can then be processed and analyzed in various ways.

**Affiliation Engines** The most popular networking sites, and especially Facebook, rely less on a specific method and more on persuading people to join and build a social graph from the bottom up. In these cases the social networking dimension is clear, but the relevance of the methods and tools that are the focus of this paper may be less obvious. Facebook's success was partially predicated on making it easy for users to find people they knew and, subsequently, making it a routine to observe the ebb and flow of

activity on one's network one or two degrees out. The periodic controversies over the degree of information that Facebook makes available, and the ease with which users may reveal information about themselves or their friends, reflect the organization's desire to see what, if anything, might define the upper limit of users' willingness to feed large quantities of mundane but intrinsitcally relational data to it.

Tellingly, Facebook has become very attractive to social scientists because it implements a rich model of affiliation and (unlike the internet as a whole) it might in principle provide access to the complete social graph of its users. In this regard Facebook and its competitors appeal in much the same way as corporate settings did in the 1980s, because they can (in principle) provide rich and complete network data. The work in progress described in Rosenbloom (2007), for instance, takes advantage of this fact as researchers test theories of social affiliation and taste formation. The data used in such studies are produced by a system that implements a particular model of affiliation. This implementation provides a platform for further social interpretation by users, and analysis by experts.[12] Naturally, this opens the way to the strongest sort of performativity.

*Network Analysis and the nature of Network Data*

So far we have seen the ubiquity of formal methods of network analysis built in to the workings of a variety of websites and web services. These methods are what allow the kinds of network-building, category-making, equivalence-discovering features of these websites to work. The examples covered demonstrate, I think, how well-established the generic employment of network images and methods are, and how effective they are in enabling various useful things to happen. What about the third and strongest kind of performativity? Recall that Barnesian performativity, as defined by MacKenzie, requires that the use of economics actively alter processes "in ways that bear on their conformity to the aspect of economics in question" (MacKenzie 2006, 19). That is, the model or theory must bring participants into line with its picture

[12] Two cultural aspects of these networks are beyond the scope of this paper. The first is that they generate a vocabulary and set of conventions of their own with respect to the forms of connectivity they enable (what makes for a "Facebook Friend," for example). The second is the strong parallel between the anxiety and cultural criticism associated with growth and participation in these networks and the anxiety that accompanies the spread of markets and commodification in other settings. The parallels are really quite strong, with the most anxiety being associated with the activities of the young (teenagers, etc) on the one hand, and with services whose only purpose is to connect individuals rather than to accomplish some other end. Thus, like critiques of the commodification of friendship or sex or organs and so on, anxiety about networking is weak or non-existent in cases like Amazon's recommendation system or LibraryThing's book catalogs or Rhapsody's music matching systems, where some consumable product provides a narrow rationale for the method's application; and stronger the more the whole person (and only the person) is involved, such as with pure social networking sites.

of the world. In that case the model helps make itself true, in the sense that before the its public appearance the system did not behave in accordance with the model's predictions, whereas subsequently it does. Naturally, it is also possible that a model might undermine the real-world viability of the process it describes. That would be a "counterperformative" effect.

This is a straightforward thesis to state but it is hard to specify or observe in practice. MacKenzie's case for it rests on the career of the Black-Scholes-Merton formula for pricing options. MacKenzie documents the development of the theory behind option pricing and its subsequent application in practice. He argues that the appearance and application of the BSM formula had three main effects. First, the model's power and elegance legitimated the business of options trading: "it undermined the long-standing cultural association between options and gambling" MacKenzie (2006, 158). The fact that the basic equations were published work rather than private methods eased their acceptance. Second, Fischer Black sold elegantly-constructed sheets containing Black-Scholes values for options (and associated information) that traders could use on the floor while doing their work. They simplified the process of making trades, though traders using them were occasionally mocked as not being man enough to work without them. Third, MacKenzie argues that the model was put to use in "spreading," the identification of pairs of options on the same underlying stock where one member of the pair was underpriced with respect to the other. Here MacKenzie sees Barnesian performativity in action, because the method that traders used to identify the discrepancies in option prices was the same, in essence, as the one academic researchers used to assess the accuracy of the model itself:

> The most thorough tests of fit were conducted by Mark Rubinstein (1985) ... [In essence] Rubinstein checked whether the graph of implied volatility against strike price was a flat line, as it should be on the model. There was thus a homology between the econometric testing of the Black-Scholes-Merton model and the trading-floor use of the model in "spreading." When spreaders used the model ... it would be precisely deviations from that flat line that they would have identified and that their activities would have tended to "arbitrage away." It seems, therefore, that the model may have been helped to pass its central econometric test ... by the market activities of those who used it (165).

This is MacKenzie's strongest example of Barnesian performativity, "a direct performative loop between 'theory' and 'reality'" (165). The mechanism here is of great interest because it is not what we typically mean when we say that economic theory has the capacity to make itself true by successfully implanting itself in our minds. Some critics have worried, for example, that the spread of the rhetoric of commodification

makes people forget that their motives and actions are not all that well-described by the self-interested vocabulary they use. And experiments in social-psychology and behavioral economics have found that exposure to the lessons of undergraduate economics makes people more selfish (or rational, if you prefer), and more likely to behave like *homo economicus*. Nothing like this is happening in the case of option pricing. The setting is already a market, and the self-interested motivations of traders do not change a bit. Rather, the model is put to use prospectively in essentially the same way that a researcher would go about testing it retrospectively. It is adopted in practice in a way that mirrors its assumptions and prescriptions. This correspondence is what causes the gap between theory and practice, between economics and reality, to narrow. Moreover, the narrowing happens from the side of practice: by employing the formula to identify and exploit profit opportunities, market actors moved observed prices closer to what the model predicted should be observed.

Is there a parallel in the network case? In the previous section we saw a range of Web 2.0 services that put calculative devices in the hands of users in interesting ways. These devices acted as "cognitive prostheses," in Callon's phrase—they allow users to do things they were unable to do before, such as easily see three or four degrees out of their social network, or discover which of thousands of strangers is most similar to them in their taste in books, or quickly locate people with similar financial goals, and so on. It is a relatively short step from here to taking advantage of these tools in ways that bear on actors' conformity to some aspect of network theory. To take a simple but significant example, Facebook uses its data on the global structure of the social graph to routinely suggest lists of "people you may know" to users, with goal of encouraging users to add those people to their network. In this way, the application works automatically to encourage the closure of forbidden triads in the network — something which, in theory, should be the case anyway — and likely also to increase the degree of measurable homophily in the network. Were a complacent analyst subsequently to acquire some portion of the Facebook social graph and run some standard tests on the network's structure without, they would find — to their satisfaction — some confirmatory results about the structure of "people's social networks."

The case of homophily provides a suggestive example of counterperformativity, too. As affiliation engines build a social graph, developers and site managers may find homophily becoming a problem, as not enough interesting things are happening given that everyone in your network is much like oneself. So, the goal is to find a way to keep things varied. One commentator puts it this way:

> If you don't buy into homophily completely, what can you do? Recommendations increase your pool of interest in very short steps. To break homophily, recommend something for reasons other than "this meshes very tightly with your profile". This seems heretical at first: the whole

> logic behind recommendations is to guess at items the user will probably like. But it has to happen. For you to identify their complete region of interests, you necessarily have to show them things in and out of that region. ... Doing this creates *serendipity*: pleasantly surprising the user. ... Another way to build in serendipity is to have pivotal navigation: tags, top ten lists, and Flickr's interestingness measure are all ways to break people out of whatever group they're in and take them to something new. Links are at the heart of this: we've all been lost in clicking our way through a drunkard's walk of the Internet at one point or another. Inspire that in people: build those links and the metadata behind them into your site from the get-go. Your challenge for this week: spot the social software features of a site you use that encourage homophily, and figure out two ways to break that homophily (Torkington 2006).

What is counterperformative from one theoretical perspective might be seen as performative from another: a recommendation to break homophily by way of manufacturing conditions for serendipity might be thought of as a move from Lazarsfeld and Merton (1954) to Merton and Barber (2004).

Now, consider the case of Google. It is important to note that although it is older than the "Web 2.0" wave of startups, Google was a pioneer in the methods now associated with the latter. As Graham (2005) remarks,

> Suppose you approached investors with the following idea for a Web 2.0 startup: "Sites like del.icio.us and flickr allow users to 'tag' content with descriptive tokens. But there is also huge source of implicit tags that they ignore: the text within web links. Moreover, these links represent a social network connecting the individuals and organizations who created the pages, and by using graph theory we can compute from this network an estimate of the reputation of each member. We plan to mine the web for these implicit tags, and use them together with the reputation hierarchy they embody to enhance web searches." How long do you think it would take them on average to realize that it was a description of Google?

As is well known, the PageRank algorithm allows Google to order search results based on a calculation of the reputation of pages it finds, where reputation is roughly the number of links a page received, but with the importance of each incoming link itself weighted by the reputation of the page it comes from. In the early papers defining the PageRank method (e.g., Page et al. 1998), Google's founders explicitly link their approach to network-based methods of citation counting in library science. PageRank

effectively treats webpages as a giant adjacency matrix and calculates the eigenvector centrality of the matrix. In this respect it is straightforwardly a network measure.[13]

In the case of the Internet, Google is the first and still the major example of the power of figuring out the right metric. Their methods take advantage of properties of the network structure itself, and there is more at work than just the generic use of network imagery. The PageRank system helps reveal this structure to users, and allows users to do things with it. In the absence of effective search, many actions would not be doable at all, or could not be done nearly as efficiently. (Indeed, it is worth rereading Page et al. (1998) to see just how poorly its main competitors at the time performed by comparison.) Once it became known that Google's results were also effectively a measure of reputation, other uses for its results suggested themselves.

A key problem for the Barnesian version of the performativity thesis is to explain the success of a formal model in some market. MacKenzie sees this difficulty but does not fully resolve it. In particular, it is unclear what the relationship is between the sociological feedback loop MacKenzie identifies and the substantive accuracy of the model in practice. As he notes, not just any bit of algebra could have been "performed" successfully: if a formula with a serious mistake in it was put to work on the trading floor, it would have created exploitable errors and quickly been driven out. But if we grant that, on balance, the circumstantial evidence tends to favor Barnesian performativity in the case of BSM, then it is equally plausible to say that Google's PageRank formula was performative in much the same fashion.

PageRank boiled the complexity of search on the network down to an algebraic expression. It began life as an academic exercise in discovering a better method for finding what you wanted online, and when released "into the wild," so to speak, it was fantastically successful on its merits. It became embedded in the online practices of a majority of Internet users, and subsequently became the focus of efforts to further assess its quality, and indeed to probe and if possible exploit its weaknesses. In this respect, the method transformed professional understandings of what search results were, shifting them from a paradigm rooted in an analogy to entries in a catalog or directory to one that understood high ranking in search results as the outcome of a reputational process within a network. Academic analysis acknowledged its practical dominance, on the one hand, and its place in a family of well-known related methods, on the other (Langville and Meyer 2005). While the broad outlines of the PageRank method were public from Google's beginnings (though the details of its fine-tuning have never been), and so knowledge that Google's method was robust and based on reputation-weighted links may well have led users to adjust—or at least become more self-conscious—about the rank of their own sites, and that of those they sought links from. It gave birth to a

[13] For some sense of the history of these methods within the field, see Wasserman and Faust (1994, 199-214), and papers such as Katz (1953), Bonacich (1972, 1987), and Borgatti (2005).

mini-industry euphemistically named "Search Engine Optimization" that in essence attempted to beat Google's methods by leveraging them, in a way very similar to the actions of traders looking for anomalies in options pricing. These efforts led to the discovery and spread of several "corner" cases such as "Googlewhacking" and "Google Bombing," for instance. And once the anomalies were exposed and exploited, the PageRank algorithm was modified in order to make the particular technique less effective or to eliminate it altogether. In all of this, the calculation of modified eigenvector centrality was leading a social life not very different in principle from the BSM equation.

## THE PERFORMATIVITY OF WHAT?

What should we make of the performativity thesis in the light of the network case? Those who have applied the idea to financial markets might see the network case as evidence for the robust generalizability of the thesis. Network theorists might argue that their methodological innovations make for allow pre-existing relations to be discovered, rather than created. Institutionalists could plausibly claim that performativity is best understood as a species of normative isomorphism. I suggest that none of these interpretations is satisfactory.

If there is a strong disanalogy between between the performativity of economics and the performativity of social network analysis, it may lie in differences in the connections of each to their respective intellectual precursors. In the case of economics, one might claim that the methods put into practice in market technologies were rooted fairly strongly in that discipline, and there is a direct connection between the work of particular economists—Modigliani and Miller, Treynor, Sharp, Black et al.—and the transformation of financial practice. The same does not seem to be true of network analysis. The methods discussed above, from PageRank to the clustering and equivalence methods at the heart of Web 2.0 sites, have diverse roots. Some come from computer scientists in the world of machine learning; some from researchers in library or information science; some grew out of statistical methods for the identification of clusters and the reduction of high-dimensional data; some are based on the analysis of complex systems; and some are rooted in social network analysis as practiced by sociologists. Formally, many of these methods are very similar. All of them have been given a big push by the rise of cheap computing. They are part of a general toolkit of applied statistics rather than the product of a particular field's needs.

This argument is not quite right, however. It rests on an illegitimate winnowing of the disciplinary history of economics and finance in order to sharpen the contrast with the heterogeneous origins of network methods. But the technical methods of economics and finance have variegated roots, too, and do not form a single line of

development going back to, say, the first marginalists. Indeed, the relationship between the technical core of modern economics and the toolkit of other technical fields in the 19th and early 20th centuries is a subject of some controversy (Mirowski 1989, 2001). Moreover, while modern finance is closely connected with economics, it is not an accident that it is a separate discipline with its own system of qualifications and not a subfield of economics.

Consider the "what" question with respect to the models implied by the embedding of network methods in online services. As the history of social network analysis itself makes clear, formal methods can be placed in the service of quite different visions of social process. The consolidation of social network analysis in sociology came out of an effort to place classical concepts of social roles and solidarity on a new footing. But the expansion of the field and its first successes out in the world came out of an interpretation that stressed the instrumental benefits in terms of strategic power and sheer profit that the cultivation of certain sorts of networks might bring.[14] Today, the data-generating capacity of online services has allowed the original, more comprehensively sociological vision of network analysis to return to the fore, as practices (such as the formation and maintenance of friendship ties) that previously left little in the way of quantitative material to work with now leave usable traces as a matter of routine. Network metaphors and methods are being built in to social practices in ways that at once provide new, theoretically-informed tools for social actors and notionally "raw" data for social network analysts.

The comparison with economics is instructive. The rise of economistic models of thought are often decried for their insidious diffusion into all aspects of life. Often, quantification is seen as the handmaiden of instrumentalization, as system consumes lifeworld one bit of formal measurement at a time. The performativity of economics is the latest and one of the more sophisticated account of the progress of this disciplined and disciplinary vision. Economics is seen to take a world posited in theory and implement it in practice by way of trained professionals and their box of methodological techniques. And yet, as discussed here, a family of powerful quantitative methods and formal models exists which treats data and metadata in network terms. These methods are being used not just in the retrospective analysis and description of the World Wide Web's structure, but also prospectively in its construction and ongoing expansion. Accounts that stress the undoubted power of economic models and their realizability in practice should not blind us to the enormous expansion in the performative capacity of the network toolkit in the past ten years. That capacity is increasingly expressed in the construction, extension and visualization of systems that emphasize affiliation, connectivity and the flow of generalized exchange. In this sense, the performativity

[14] As Burt (1992, 24-25) remarks, "Judging friends on the basis of their efficiency is an interpersonal flatulence from which friends will flee." But, business is business.

of networks might be opposed in practice to the performativity of economics. But as relational methods become pervasive, more and more sources of "raw" data about structures of affiliation will be generated as a matter of routine by network-theoretic tools. Network analysis might soon find itself in a similar position to finance, testing and validating its methods by analyzing a world built with tools of its own devising.

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