

Economic Analysis of Social Interactions

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Abstract

Economics is broadening its scope from analysis of markets to study of general social interactions. Developments in game theory, the economics of the family, and endogenous growth theory have led the way. Economists have also performed new empirical research using observational data on social interactions, but with much less to show. The fundamental problem is that observable outcomes may be generated by many different interaction processes, so empirical findings are open to a wide variety of interpretations. To make sustained progress, empirical research will need richer data, including experiments in controlled environments and subjective data on preferences and expectations.

Economists have long been ambivalent about what social interactions constitute the proper domain of the discipline. The narrower view has been that economics is primarily the study of markets, a circumscribed class of institutions in which persons interact through an anonymous process of price formation. The broader view has been that economics is defined fundamentally by its concern with the allocation of resources and by its emphasis on the idea that people respond to incentives. In this view, economists may properly study how incentives shape all social interactions that affect the allocation of resources.

Throughout much of the 20th century, mainstream economics traded breadth for rigor. In the first half of the century, institutional economics, which thought broadly but loosely about social interactions, gradually gave way to the neoclassical theory of general competitive equilibrium, which formalized the analysis of idealized competitive markets (for example, Arrow and Hahn, 1971). From the perspective of general equilibrium theory, nonmarket interactions were not phenomena of intrinsic interest. Instead, they were problems of incomplete markets that may prevent the economy from achieving a social optimum. Welfare economics prescribed that the externalities created by nonmarket interactions should, if possible, be eliminated by setting property rights that would permit trade to take place (for example, Coase, 1960).

The narrowing of economics ended by the 1970s. Since then a new phase has been underway, in which the discipline seeks to broaden its scope while maintaining the rigor that has become emblematic of economic analysis. Major theoretical developments in microeconomics, labor economics, and macroeconomics

have played important roles in launching this new phase.¹

In microeconomics, perhaps the defining event of the late 20th century was the adoption of noncooperative game theory as a language and set of tools for the study of market and other interactions. The concepts of dynamic game theory developed in the 1970s and 1980s enabled economists to describe and analyze a broad range of market structures, and so gave new life to the field of industrial organization. A more radical consequence of the game theory revolution was that it broke down the sharp distinction that economists had maintained between markets and other social interactions. Game theory encouraged economists to see all interactions as games, with markets as special cases. As a result, economic theorists have in recent years studied phenomena as far from traditional economic concerns as the evolution of social norms (for example, Akerlof, 1980; Jones, 1984; Cole, Mailath, and Postlewaite, 1992; Kandori, 1992; Young, 1996).

A second pivotal development was the transformation of labor economics from a field narrowly concerned with work for pay into one broadly concerned with the production and distributional decisions of families and households (for example, Becker, 1991). Modern labor economists study a wide range of family and household behaviors that earlier economists thought peripheral to or outside the domain of the discipline; marriage and fertility, education and health care, drug addiction and criminal activity, inter vivos transfers and bequests. Much of the research of labor economists on these subjects has viewed the family or household as a single utility-maximizing entity, thus abstracting from the complex interactions that may occur among the members of this entity. A considerable body of work, however, uses noncooperative game theory to model families and households as groups whose members may have differing objectives (Becker, 1974;

Bergstrom, 1989).

A third important development was the emergence in macroeconomics of endogenous growth theory. Whereas classical growth theory assumed that the production technology available to an economy is exogenous, endogenous growth theory supposes that today's technology may depend on earlier investments in human capital or R&D, which themselves may have been influenced by the past output of the economy (Nelson and Phelps, 1966; Lucas, 1988; Romer, 1990). Endogenous growth theory has also generated study of cross-sectional and dynamic spillovers in the production of human capital: children may learn more when they share school classes with high achievers or when they have well-educated parents (Benabou, 1996a, b).² Many of the interactions in R&D and human capital formation emphasized in endogenous growth theory occur in nonmarket environments. Hence, new research on macroeconomic growth shows a concern for externalities that was absent from classical growth theory.

The broadening of economic theory has coincided with new empirical research by economists on social interactions. Unfortunately, the empirical literature has not shown much progress.

One problem is an unfortunate dearth of clear thinking in the empirical literature. Empirical economists may borrow jargon from sociology and social psychology, and write that they are studying "peer influences," "neighborhood effects," "social capital," or some other concept. Yet empirical analyses commonly fail to define these concepts with any precision, and often explain only obliquely how the reported findings shed light on the interactions being studied. Many studies maintain little or no connection to economic theory, and instead seek only to determine whether statistical associations among the experiences of

different persons indicate the presence of some loosely specified form of interaction amongst them.

The second, more fundamental problem is the inherent difficulty of inference from the data that economists commonly bring to bear to study social interactions. The prevailing practice has been to try to infer the presence of interactions from observations of the outcomes experienced in a population of interest. However, the observed outcomes of the population can usually be generated by many different interaction processes or, perhaps, by processes acting on individuals in isolation. Hence the findings of empirical studies are often open to an uncomfortably wide range of interpretations.

The weak state of empirical research on social interactions should be a matter of concern both to economists with a policy focus and those with a theoretical focus. For years, economists have speculated about the role of nonmarket interactions in determining such matters of public interest as schooling outcomes, employment patterns, participation in welfare programs, crime rates, and residential segregation. To inform policy, we need to replace speculation with sound empirical analysis. Economic theorists need to know what classes of social interactions are prevalent in the real world. Otherwise, theory risks becoming only a self-contained exercise in mathematical logic.

How might economists progress in the empirical analysis of social interactions? Empirical researchers will need to become much more specific about the questions they address. I also see a compelling need to enrich the data that researchers bring to bear. Empirical analysis of social interactions would particularly benefit from performance of well-designed experiments in controlled environments and from careful elicitation of persons' subjective perceptions of

the interactions in which they participate.

Perspectives on Social Interactions

Coherent study of social interactions requires a clear conceptualization of interaction processes. What are the units that interact with one another? How do they interact? The social sciences have yet to form a common set of answers to these basic questions. There does, however, seem to be a consensus that the perspective of economics is so distinct as to separate economics from the other social sciences. Indeed, the distinctiveness of economics is institutionalized in the name of the major unit of the National Science Foundation that houses the NSF Economics Program -- the Directorate for Social, Behavioral, and Economic Sciences. Here, I will describe what I see as the main elements of economic thinking on social interactions, and then compare them with perspectives in sociology.

Social Interactions in Economics

The particularity of economics begins with its conceptualization of agents as decision-makers endowed with preferences, forming expectations, and facing constraints. Preferences are given formal expression through utility functions, expectations through subjective probability distributions, and constraints through choice sets. Economists usually go on to assume that agents maximize expected utility, but we shall not require this degree of specificity for the present discussion.

In economic terms, agents are the units who interact with one another. The

notion of an agent embraces persons, firms, and other entities such as nonprofit organizations and governments. The essential characteristic of an economic agent is not its physical form but rather its status as a decision-maker.

The concept of an agent as a decision-maker carries within it a straightforward answer to the question of how agents interact. Agents interact through their chosen actions. An action chosen by one agent may affect the actions of other agents through three channels: constraints, expectations, and preferences.

Constraint Interactions

Markets with price taking consumers and firms form the classical economic illustration of constraint interactions. The decisions of consumers and firms to demand and supply commodity bundles collectively determine prices, which in turn determine the bundles that are feasible for consumers to purchase.

Another familiar form of constraint interaction is congestion, which may occur when multiple agents share a common resource. Whereas market analysis imagines agents endowed with money budgets who purchase commodities having money prices, congestion analysis often imagines agents endowed with time budgets who choose activities that consume time. The time cost of some activities depends on the number of agents choosing them; road travel, web surfing, and restaurant dining are examples. The decisions of agents to engage in these activities collectively determine their time costs, which in turn determine the activity bundles that are feasible for agents to choose.

Markets and congestion exemplify negative constraint interactions; the more that some agents choose a commodity or activity, the less available it is to

others. In contrast, decisions by agents to engage in research and development may generate positive constraint interactions. Research and development enlarges the production set of the agent performing it. To the extent that findings are public knowledge, R&D by one agent enlarges the production sets of other agents as well.

Expectations Interactions

Economic analysis supposes that an agent facing a decision problem will form expectations of the outcomes that would follow from choosing different actions. An agent forming expectations may seek to draw lessons from observation of the actions chosen and outcomes experienced by others. Some studies assume that only actions are observable, while others assume that actions and subsequent outcomes are observable. In general, economists have assumed that agents do not directly observe the expectations of other agents. In any case, observational learning generates expectations interactions.

Expectations interactions pervade the modern economics of information. A central concern is to understand the interactions of agents who know that other agents possess private information. A recurring theme is that observation of chosen actions may reveal private information; for example, health insurance purchases may reveal consumers' health status and acceptance of job offers may reveal workers' skills (Akerlof, 1970). This theme takes particularly strong form in the theory of efficient markets, where observation of prices suffices to reveal all relevant private information.

Statistical discrimination is an information interaction (Arrow, 1973; Cain, 1986). An employer who observes the job performance of current employees

with certain demographic attributes may use this information to forecast the performance of new job applicants with similar attributes. A provider of insurance may likewise use data on the claims paid to current policyholders with certain covariates to forecast the claims that would be payable to new applicants with these covariates.

Economists have not been unanimous in the view that expectations interactions form an important subject for study. A large part of modern economic analysis presumes that agents have rational expectations, wherein agents' subjective beliefs about future events are the best predictions possible given the available information. Studies assuming rational expectations typically do not attempt to explain how agents may come to form such optimal forecasts. This fundamental question is addressed only in a relatively small literature seeking to characterize when observational learning processes will or will not generate rational expectations (Cyert and DeGroot, 1974; Kalai and Lehrer, 1993).

There is reason to think that many observational learning processes do not generate rational expectations. A concrete instance may help in making my objection clear. In Manski (1993a), I pointed out that youth who are forming earnings expectations as they contemplate schooling choices confront the same inferential problems as do labor economists when they study the returns to schooling. The literature on labor economics exhibits much debate on the credibility of various assumptions and many disagreements about findings. If experts disagree on the returns to schooling, is it plausible to assume that youth have rational expectations?

Preference Interactions

Preference interactions occur when an agent's preference ordering over the alternatives in a choice set depends on the actions chosen by other agents. Such everyday ideas as conformism, jealousy, and paternalism suggest forms of preference interaction. Neoclassical consumer theory long rejected these ideas in favor of a presumption that agents care only about their own consumption, or perhaps only about the consumption of their families. Yet there is nothing in the logic of economic thought that mandates this narrow view of preferences (Pollak, 1976).

Preference interactions are at the heart of noncooperative game theory. The standard setup considers a set of agents who simultaneously choose actions, each from the agent's own choice set. The utility that each agent receives depends on the actions chosen by the other agents. Hence an agent's preference ordering on the alternatives in that agent's choice set depends on the actions chosen by the other agents.

A simple example is the Schelling (1971, 1978) model of residential segregation. Here the choice set is a set of alternative neighborhoods in which one might reside. Schelling supposed that the utility a person associates with each neighborhood may depend on the racial distribution of the persons who choose to reside there. Another simple example is the formation of driving conventions in the absence of road laws, as discussed by Young (1996). Each driver chooses between driving on the right or the left side of the road. The utility of driving on one side or the other clearly depends on the choices made by other drivers sharing the same road.

Equilibrium

If economics were content to describe how agents may interact, an extended version of the above verbal discussion might suffice. However, economists want to characterize the outcomes of interactions processes, and for this purpose, words do not suffice. Thus, economists commonly pose formal models of agent behavior and explicit specifications of the manner in which chosen actions may affect constraints, expectations, and preferences.

The discipline has long focused attention on equilibrium outcomes; that is, outcomes that occur when agents' actions are mutually consistent. Much of the theoretical literature has been concerned with qualitative questions like the existence and uniqueness of equilibria. Economists have gone further and reported illuminating algebraic or graphical analyses of some simple interaction processes. At the same time it has become clear that many processes of substantive interest are too complex to be analyzed abstractly. Hence researchers have increasingly used numerical methods to characterize the equilibria of specific processes, as well as to study their dynamics (for example, Arthur et al., 1997).

More General Processes

Thus far, I have restricted attention to processes in which agents affect each other through their actions. A more general class of interactions permits the preferences, expectations, and constraints of one agent to affect the preferences, expectations, and constraints of another agent in ways that are not mediated through actions. It is one thing to say that my preferences depend on your actions, and another to say that my preferences depend on your preferences.

In the case of expectations, the processes that we have discussed suppose that agents extract information from observation of the actions chosen and outcomes experienced of others. However, agents may also obtain information directly from one another. After all, humans do communicate about all sorts of things.

Social Interactions in Sociology

A sense of the particularity of economic thinking emerges when one compares economics with sociology. The sociologist Charles Camic (1987) has written engagingly on how the discipline of sociology emerged out of economics. According to Camic, separate university departments of sociology came into being as a consequence of the triumph of neoclassical economics over institutional economics in the 1920s and 1930s. As neoclassical economists sought to formalize the analysis of market interactions, they disparaged the broad but loose study of social interactions characteristic of institutional economics. Sociology departments emerged to study the range of nonmarket interactions that neoclassical economists judged to be outside the proper domain of the discipline of economics.

Sociology has had a substantial period of time within which to develop as a separate discipline, so one might expect a coherent sociological analysis of social interactions to have developed by now. Not so. Examination of recent sociological research does not reveal a shared, discipline-wide perspective. Some sociologists describe interactions in language that suggests economic thinking. Others give prominence to concepts that play little or no role in modern economics: class, community, culture, influence, status, gender roles, and so on. Indeed, an economist reading sociological research is struck by the sheer

number of concepts that sociologists employ. Economics has sufficed with a remarkably small set of basic concepts: preferences, expectations, constraints and equilibrium. Why does sociology require so many more concepts?

I believe that the abundance of concepts in sociology is connected closely to the dearth of formal analysis in the discipline. Whereas the typical research article in economic theory uses mathematical language to define concepts and then goes on to state and prove propositions, most articles in sociological theory begin and remain verbal throughout. There was a period in the 1960s and 1970s when sociology seemed to be on the verge of a methodological transformation that might yield a rigorous discipline akin to economics. Social network analysts developed a formal, graph-theoretical language to represent the myriad informal bonds that connect humans to one another (for example, Holland and Leinhardt, 1970). James Coleman (1964) sought to lay the foundations for a mathematical representation of sociological theory. The Journal of Mathematical Sociology began publication in 1971. The sociological methodologist Otis Dudley Duncan worked with the econometrician Arthur Goldberger to develop a common empirical approach to analysis of market and non-market interactions (Goldberger and Duncan, 1973). For whatever reason, the transformation did not take hold. Indeed, sociology today appears no more rigorous a discipline than 30 years ago.

Verbal reasoning may sometimes be more evocative than mathematical argument. For example, the Wilson (1987) discussion of the underclass is compelling in ways that formal analyses of social mobility cannot hope to match. However, verbal reasoning is also less precise than mathematical argument. The ambiguity of words permits a proliferation of concepts. Readers of verbal sociological research can never be certain that they understand a concept, nor

the relationship among concepts, in the way that an author intends. Hence they cannot readily distinguish between basic concepts and others that are derivative or, worse, ill-defined.

An apt illustration is the term "social capital," which came into vogue in the 1990s. There is some uncertainty about the origin of the term. Many associate it with Coleman (1988) and Putnam (1993), but Durlauf (1999) credits it to Loury (1977) and Glaeser et al. (1999) date it back to Jacobs (1961). Also see Portes (1998). The origin of "social capital" should be a resolvable matter, but the meaning of the term may not be. So many authors have sought to define the term in so many ways that I shall make no attempt to provide my own definition here. I find revealing, however, the thoughtful recent efforts by Durlauf (1999) and Bowles (1999) to come to grips with "social capital."

Durlauf (1999, page 2) writes

"One problem with the analysis of social capital is that it is ill-defined, with different authors attributing different meanings to the concept. Part of this ambiguity concerns whether social capital is defined in terms of its effects or in terms of its characteristics. The problem with a functional definition is that it renders analysis impossible since, as argued by Alejandro Portes, social capital becomes tautologically present whenever a good outcome is observed."

Durlauf goes on to offer a possible definition of social capital as "the influence which the characteristics and behaviors of one's reference groups has on one's assessments of alternative courses of behavior." He remarks that this definition is consistent with that of Laumann and Sandefur (1998), who wrote that an individual's social capital "consists of the collection and pattern of

relationships in which she is involved and to which she has access."

Bowles (1999) puts it this way:

"Perhaps social capital, like Voltaire's God, would have had to be invented even if it did not exist. It may even be a good idea. A good term it certainly is not. "Capital" refers to a thing possessed by individuals; even a social isolate like Robinson Crusoe had an axe and a fishing net. By contrast, the attributes said to make up social capital -- such as trust, commitment to others, adhering to social norms and punishing those who violate them -- describe relationships among people and would have been unintelligible to Robinson before Friday showed up. As with other trendy expressions, it attracts disparate meanings like flypaper. So many are now firmly attached that it seems better to abandon the term in favor of something more precise."

Bowles goes on to propose adoption of the venerable term "community" which, he states, "better captures the aspects of good governance that explain the popularity of social capital."

As I see it, the relevant question for economists is whether "social capital," "community," and other sociological concepts convey ideas that are missing in modern economic thought; ideas that cannot be expressed using the core concepts of preferences, expectations, constraints, and equilibrium. If so, the ongoing efforts to interpret "social capital" may be productive. If not, economists should use "social capital" only as a lesson in the ambiguity of words.

Empirical Analysis of Observed Outcomes

Throughout the modern development of economics, empirical analysis of social interactions has lagged far behind theory, with distressing consequences. Even the most ambitious economic theory typically leaves the magnitudes of critical quantities -- demand elasticities, returns to scale in production, time discount rates, risk preferences, and so on -- to be determined empirically. Empirical analysis is essential to determine which theories should be taken seriously as descriptions of the world as it is, rather than as it might hypothetically be.

The practice in empirical economics has been to infer the nature of an interaction process from observations of its outcomes. However, outcome data typically have only limited power to distinguish among alternative plausible hypotheses. Almost every student in economics receives instruction on one instance of the problem of identification of social interactions: the difficulty of drawing inferences on supply and demand from observations of prices and quantities in competitive markets in equilibrium. I begin with this familiar case and then move on to problems of drawing inferences about other interaction processes.

Econometric Analysis of Markets

The theory of equilibrium in competitive markets was well under development over a century ago, but the corresponding problem of empirical inference on demand and supply was only dimly understood until the 1940s. The central finding of this time was that observation of equilibrium prices and quantities does not

suffice to untangle the market interaction of consumers and firms, even if one somehow knows a priori that demand and supply functions are linear. (Of course, economic theory gives no reason to think that demand and supply functions are generally linear. Nevertheless, it was reasonable for early econometricians to begin with the study of linear models if only because they are relatively easy to analyze.) The reason is that observation of price and quantity in equilibrium reveals only that demand and supply intersect at this point. There are innumerable pairs of linear functions that intersect at any given point. Some further prior information is necessary if one is to distinguish demand and supply from one another.

This further information can take various forms, but the essential requirement is expressed well in the familiar idea of exclusion restrictions; that is, a priori knowledge that some factor affects supply but not demand, while some other factor affects demand but not supply. Economists have become well aware that credible exclusion restrictions or other identifying assumptions are elusive in practice. Thus, the early econometrics literature on identification of linear simultaneous equations has made economists appreciate the subtlety of inference on social interactions.

It has now been a half-century since the codification of econometric analysis of linear simultaneous equations in the work of the Cowles Commission (Hood and Koopmans, 1953). How has structural econometric analysis of market interactions progressed since then? The answer has two parts, presently in much tension with one another.

Part of the answer is that the early restriction of empirical analysis to market settings that can reasonably be represented by linear simultaneous

equations has been overcome as a result of the development of econometric methods for estimation of nonlinear models of consumer and firm behavior.³

However, the other part of the answer is that structural analysis of markets remains as subtle an inferential problem as it was 50 years ago. Modern developments in econometric method do not -- indeed cannot -- resolve the basic identification problem that economists have long appreciated. Observation of market transactions reveals only so much about the determinants of the behavior of consumers and firms. Today, as 50 years ago, structural econometric research interprets data on transactions with the assistance of exclusion restrictions and through the lens of tightly specified models of consumer and firm behavior, chosen in large part for their tractability. Today, as 50 years ago, empirical findings are only as credible as the particular exclusion restrictions and modeling assumptions imposed.⁴

The uncomfortable bottom line is that modern empirical researchers can analyze a wide range of interesting market interactions, but only if they are willing to maintain strong assumptions that may be difficult to motivate. The result has been much controversy in empirical economics, with researchers segmenting into one camp that retreats from the objective of econometric analysis of market interactions and another that continues to report findings while recognizing that the underpinning assumptions may lack credibility.

In macroeconomics, one form that this controversy has taken is a debate about the value of "calibration" exercises in which key parameters of theoretical models are tweaked or "calibrated" so that the predictions of the model appear realistic, and then "computational experiments" are run with the model. This

practice was the subject of a *Journal of Economic Perspectives* symposium with contributions by Kydland and Prescott (1996), Hansen and Heckman (1996), and Sims (1996). In labor economics, empirical researchers using data on observed outcomes to perform structural econometric analysis have become estranged from ones who hold that empirical research should be based as closely as possible on the paradigm of randomized experimentation; for example, compare the analysis of the returns to schooling in Willis and Rosen (1979) with that of Angrist and Krueger (1990).

I have for more than a decade advocated a mode of empirical research that explicitly recognizes the tension between strength of assumptions and credibility of findings. As described in Manski (1995), one begins with a conservative analysis that imposes only assumptions enjoying considerable consensus. Such assumptions typically imply bounds on parameters of interest, rather than point estimates.⁵ One then invokes further assumptions that yield stronger findings at the cost of diminished credibility.

Econometric Analysis of Games

A wide spectrum of social interactions, from divorce proceedings to union-management negotiations, can usefully be thought of as noncooperative games, with each player choosing an action from some set of feasible alternatives. It is common to assume that the players have reaction functions specifying the action that each would choose as a function of the actions chosen by the others. An equilibrium of the game is a set of mutually consistent actions; that is, a situation in which all players are happy with their own choice, given the choices of other players.

Consider, for example, labor economists studying interactions within the family. McElroy (1990) has interpreted data on the labor supply of husbands and wives as the equilibrium of a game in which the hours worked by each spouse varies with the hours worked by the other spouse. Rosenzweig and Wolpin (1994) applied game theory to interpret data on intra-family monetary transfers. Flinn and Del Boca (1994) interpreted data on child custody outcomes in divorce proceedings as the equilibrium outcome of a game in which the separating spouses and the government are the players.

Attempts to learn about players' reaction functions from observation of game equilibria encounter the same fundamental identification problem as arises in inference on the supply functions of quantity-taking firms and demand functions of price-taking consumers from observations of market equilibria. Hence empirical research on games generates the same tension between assumptions and credibility. Indeed, many games are much more complex than competitive markets. Players may be uncertain of each other's strategies, equilibria may not exist or may not be unique, and so on. These complexities, when taken seriously,

intensify the inferential problem considerably. For example, problems in drawing inferences concerning games with multiple equilibria are analyzed in Jovanovic (1989) and Tamer (1999).

Experimental Research

Econometric analysis of markets and other games has generally sought to analyze data on outcomes generated as the world turns. A distinct tradition of experimental research analyzes data on outcomes generated through purposeful interventions.

As long as 50 years ago, social psychologists such as Asch (1952) reported provocative experimental findings on interactions in small groups. Jones (1984) provides an economic perspective on experimental social psychology. The 1980s and 1990s saw a blossoming of experimental research in economics, with the primary objective being to ascertain the realism of equilibrium concepts developed in game theory (Kagel and Roth, 1995). Recently, economists have performed experiments seeking to shed light on behavior in games of trust or coordination, where good outcomes occur if players cooperate with one another (Fehr and Gächter, 2000; Fershtman and Gneezy, 1998; Glaeser et al., 1999). The prisoner's dilemma is a well-known example of a coordination game.

Experimental research clearly has limitations. Only some kinds of interactions are amenable to experimental manipulation and, even then, only in somewhat artificial settings. A longstanding criticism of the experiments conducted by psychologists, and more recently by experimental economists, is that the groups whose interactions are observed are formed artificially for the sake of the experiment. This raises obvious questions about the credibility of

extrapolating findings from experimental settings to populations of interest.⁶

The limitations of experimental research should not dissuade researchers from judicious use of laboratory experiments to complement observation of naturally occurring outcomes. I expect that economists will make increasing use of experimental data in the years ahead.

Why Do Members of the Same Group Tend to Behave Similarly?

Whatever their difficulties, econometric and experimental analysis of markets and games at least aim to analyze well-defined forms of social interactions. Much recent empirical research conceptualizes interaction processes only in broad terms that lack the clarity of markets and games. A common objective has been to learn whether some form of interaction may explain the often reported descriptive finding that agents belonging to the same group tend to behave similarly.

Many social scientists have hypothesized that this empirical regularity is due to interactions in which the propensity of an agent to behave in some way varies positively with the prevalence of this behavior in the group. Such interactions may be called "social norms," "peer influences," "neighborhood effects," "conformity," "imitation," "contagion," "epidemics," "bandwagons," or "herd behavior," as in Hyman (1942), Merton (1957), Granovetter (1979), and others. Some, however, have hypothesized that similarity in behavior is due to processes operating entirely at the level of the individual; for example, Jencks and Mayer (1989) describe the long-running debate about the nature of neighborhood effects.

Stripped to its basics, empirical research has sought to distinguish among three hypotheses: 1) endogenous interactions, wherein the propensity of an agent to behave in some way varies with the behavior of the group; 2) contextual interactions, wherein the propensity of an agent to behave in some way varies with exogenous characteristics of the group members; 3) correlated effects, wherein agents in the same group tend to behave similarly because they have similar individual characteristics or face similar institutional environments.

Endogenous and contextual interactions express distinct ways that agents might be influenced by their social environments, while correlated effects express a nonsocial phenomenon. Consider, for example, the high school achievement of a teenage youth. There is an endogenous interaction if, all else equal, individual achievement tends to vary with the average achievement of the students in the youth's high school, ethnic group, or other reference group. There is a contextual interaction if achievement tends to vary with, say, the socioeconomic composition of the group. There are correlated effects if youth in the same school tend to achieve similarly because they are taught by the same teachers, or because they have similar family backgrounds.⁷

Distinguishing among endogenous interactions, contextual interactions, and correlated effects is important because these hypotheses imply different predictions for the impact of public policy. Consider, for example, an educational intervention providing tutoring to some of the students in a school, but not to the others. If individual achievement increases with the average achievement of the students in the school, then an effective tutoring program not only directly helps the tutored students but, as their achievement rises, indirectly helps all students in the school, with a feedback to further

achievement gains by the tutored students. Contextual interactions and correlated effects imply no such feedbacks.⁸

The Reflection Problem

Unfortunately, outcome data do not readily differentiate among endogenous interactions, contextual interactions, and correlated effects. In Manski (1993b; 1995, Chapter 7) I examined a familiar regression model of behavior in large groups in which individual behavior is permitted to vary linearly with mean behavior in the group (expressing endogenous interactions), with the mean values of exogenous attributes of group members (expressing contextual interactions), and with personal characteristics that may be similar across group members (expressing correlated effects). In this setting, I found that data on equilibrium outcomes cannot distinguish endogenous interactions from contextual interactions. The researcher may be able to distinguish these two forms of interactions from correlated effects, but even this limited form of inference is possible only in some situations; the exogenous attributes of individuals must vary within and across groups in certain ways.

This identification problem arises because mean behavior in the group is itself determined by the behavior of group members. Hence, data on outcomes do not reveal whether group behavior actually affects individual behavior, or group behavior is simply the aggregation of individual behaviors. This reflection problem is similar to the problem of interpreting the (almost) simultaneous movements of a person and his reflection in a mirror. Does the mirror image cause the person's movements or reflect them?

Brock and Durlauf (2000), Manski (1993b, 1997b), and Moffitt (1999)

investigate alternative models that open other possibilities for identification, in principle if not in practice. One alternative supposes that the researcher observes the dynamics of a process in which individual behavior varies with lagged rather than contemporaneous values of group mean behavior. This resolves the identification problem if one a priori knows the appropriate lag length. Another alternative supposes that individual behavior varies in a specified nonlinear manner with group mean behavior. This resolves the identification problem if one a priori knows the correct nonlinear function. A third alternative supposes that individual behavior varies with some feature of group behavior other than the mean, perhaps the median. This resolves the identification problem if one a priori knows the relevant feature of group behavior. A fourth alternative assumes the existence of an instrumental variable which directly affects the outcomes of some but not all group members. These and other alternative models may sensibly be applied in some settings but, as in econometric analysis of market interactions, empirical findings are only as credible as the identifying assumptions imposed.

The discussion thus far assumes that the researcher a priori knows the group, or groups, with whom an agent may interact. Outcome data do not reveal group composition, so researchers must somehow obtain this information in other ways. Sociologists have sometimes elicited empirical evidence on group composition from group members themselves (for example, Coleman et al., 1957; Marsden, 1990), but economists typically do not collect or use such data.⁹

Instead, economists have typically made assumptions about group composition and then proceeded with analysis. For example, the Borjas (1991) analysis of "ethnic capital" presumes that persons interact with members of their own ethnic

group; the Glaeser et al. (1996) study of social interactions in crime applies an abstract spatial model of neighbors on a lattice to precinct and city-level data; the Case (1991) study of demand interactions measures strength of the interaction by distance; and the Case and Katz (1991) study of inner-city youth defines neighborhoods as units one or two square blocks in size. Often, however, it is not obvious what the relevant groups should be. Consider, for example, the definition of "neighborhood." Should the neighborhood be an apartment house, a block, a census tract, or a city? Or might the relevant geography be that of schools, workplaces, or church parishes? What of telecommunications that may diminish the importance of physical geography entirely?

However severe the reflection problem may be when group composition is known, the problem becomes insurmountable when group composition is unknown. Mean group behavior is, by definition, the average of the individual behaviors in the group. It follows that, given any specification of group composition, the regression of individual behavior on group mean behavior is linear with coefficient one.¹⁰ Hence, when observed outcomes constitute the only empirical evidence available, a researcher who conjectures the presence of endogenous interactions within any hypothesized group cannot be proved wrong.

Inside Endogenous Interactions

Suppose that an empirical researcher is able to find credible evidence indicating the presence of endogenous interactions. If empirical analysis is to be useful for economics and policy, it needs to do more than show the presence of endogenous interactions writ large. The concept of endogenous interactions is

just too broad to be very useful. After all, this concept aggregates all three of the basic economic processes described earlier: preference, expectations, and constraint interactions. Each of these processes describes a distinct endogenous channel through which group behavior may affect individual behavior.

To make the point concretely, consider the public concern about high rates of drug use among youth in areas of concentrated poverty. Suppose that credible empirical evidence for endogenous interactions should emerge. Such evidence would leave open basic questions about the processes at work. Is it a preference interaction: for example, does the stigma associated with drug use fall as the prevalence of use rises? Or is it an expectations interaction: for example, do youth learn about the attractiveness of drug use by observing it in their environs?

To see the importance of understanding endogeneous interactions at a deeper level, consider the crack cocaine epidemic of the 1980s, which appears to have subsided during the 1990s. A plausible explanation of the course of the epidemic begins with positive expectations interactions as youth of the '80s may have observed some of their peers initiate crack usage and apparently enjoy it. There also may have been positive preference interactions of the stigma-reducing type. Eventually, however, youth of the '90s may have observed the devastating long-term outcomes experienced by addicts of the '80s, and subsequently may have chosen not to initiate crack use themselves. If this story of observational learning is correct, then an information campaign warning of the devastating effects of crack addiction might have been effective in the early stages of the epidemic, but superfluous later on.

In general, it is important to distinguish preference interactions from the

expectations interactions generated by observational learning. The phenomenon of interest may be epidemics in drug use or queuing for tables at well-regarded restaurants or herd behavior in stock trading. In these and many other situations, one person may "imitate" another because the former person prefers to act like the latter, or because he believes the latter person to have superior information.¹¹ These explanations are distinct and have differing implications for policy. Interventions that provide new information may alter the nature of expectations interactions or even cause them to disappear, but should have no effect on preference interactions.

Subjective Data for Subjective Concepts

Having devoted much of my own research to revealed preference analysis of discrete choice behavior, I have become keenly aware that observation of the action that an agent chooses places only mild restrictions on the agent's preferences and expectations. To be sure, the theory of revealed preference as pioneered by Samuelson in the 1940s and extended by Savage (1954) to the theory of subjective expected utility shows that a researcher observing many choices of a person can infer the person's preferences and expectations. However, empirical revealed preference analysis does not have the extensive data presumed available in the Samuelson and Savage thought experiments. The empirical researcher usually observes a sample of heterogeneous agents, each of whom makes a single choice from a single choice set. Observation of a single choice from a single choice set reveals something, but not much, about an agent's preferences and expectations.

Rather than try to infer preferences and expectations from observations of chosen actions, why not elicit them directly? Pose this question to an economist, and chances are that one will receive an instant hostile response. Economists tend to be deeply skeptical of subjective statements. Early in their careers, they are taught to believe only what people do, not what they say. Economists often assert that respondents to surveys have no incentive to answer questions about their preferences or expectations carefully or honestly; hence, there is no reason to believe that subjective responses reliably reflect respondents' thinking. As a result, the profession has enforced something of a prohibition on the collection of subjective data. In the absence of data on preferences and expectations, economists have compensated by imposing assumptions.

Some time ago, I began to question seriously the conventional economic wisdom about collection of subjective data on preferences and expectations. In particular, I sought to determine the scientific basis underlying economists' hostility towards elicitation of expectations, and found it to be meager (Dominitz and Manski, 1997a, 1999). The story seems to be that in the 1950s and early 1960s, economists such as Juster (1964) reported negative evidence on the usefulness in predicting consumer purchase behavior of qualitative assessments of expected consumer finances of the type advocated by George Katona (1957). This specific finding appears to have predisposed economists since then to draw the broad but unsubstantiated conclusion that all data on expectations are suspect.¹²

I subsequently began a program of research eliciting economic expectations in the form of subjective probabilities (Dominitz and Manski, 1997a, b; Manski

and Straub, 2000). Research along similar lines has been initiated by others (for example, Hurd and McGarry, 1995; Guiso et al., 1992). Enough has already been accomplished to make clear that the conventional wisdom is unfounded. Survey respondents do provide coherent, useful information when queried systematically about their expectations.

The new literature on elicitation of expectations is still in its infancy. Research needs to move beyond its current focus on measurement of expectations to the more challenging task of eliciting information on how agents form their expectations. Only when that happens will it be possible to assess the contribution that collection of subjective data can make to our understanding of expectations interactions.

Wanted: Clear Thinking and Adequate Data

Development of an informative, cumulative body of empirical research on social interactions will require clear thinking and adequate data. The very first step must be to get the concepts right. The core concepts of present-day economics -- preferences, expectations, constraints, and equilibrium -- offer a coherent framework within which one can define rigorously and analyze constructively many interaction processes. These economic concepts may not suffice to characterize all of the ways that humans interact with one another, but I cannot envision how social science might flourish without them.

The next step must be to respect both the logic and the credibility of scientific inference. Empirical researchers obviously need to understand how the conclusions of an empirical analysis depend logically on the data and assumptions

brought to bear. They must also appreciate how the strength of the assumptions they maintain affects the credibility of the empirical findings that they report.

Clear thinking is a prerequisite for productive empirical analysis but it does not suffice. The data brought to bear must be adequate to make credible inference possible. The practice has been to infer interaction processes from observations of their outcomes. However outcome data do not, per se, provide an adequate foundation for empirical research. Sustained progress will require richer data. In Manski (1993b), I concluded that experimental and subjective data will have to play important roles in future efforts to learn about social interactions. I feel even more strongly about this today.

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References

Akerlof, George, "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism," *Quarterly Journal of Economics*, 1970, 84, 488-500.

Akerlof, George, "A Theory of Social Custom, of Which Unemployment may be One Consequence," *Quarterly Journal of Economics*, 1980, 94, 749-775.

Angrist, Joshua and Alan Krueger, "Does Compulsory School Attendance Affect Schooling and Earnings," *Quarterly Journal of Economics*, 1991, 106, 979-1014.

Angrist, Joshua and Victor Lavy, "Using Maimonides' Rule to Estimate the Effect of Class Size on Scholastic Achievement," *Quarterly Journal of Economics*, 1999, 114, 533-575.

Arrow, Kenneth and F. H. Hahn, *General Competitive Analysis*, 1971, San Francisco: Holden-Day.

Arrow, Kenneth, "The Theory of Discrimination," in O. Ashenfelter and A. Rees (editors), *Discrimination in Labor Markets*, 1973, Princeton, NJ: Princeton University Press.

Arthur, Brian, Steven Durlauf, and David Lane (editors), *The Economy as an Evolving Complex System II*, 1997, Reading, MA: Addison-Wesley.

Asch, Solomon, *Social Psychology*, Englewood Cliffs, NJ: Prentice-Hall, 1952.

Banerjee, Abhijit, "A Simple Model of Herd Behavior," *Quarterly Journal of Economics*, 1992, 117, 797-817.

Becker, Gary, "A Theory of Social Interactions," *Journal of Political*

Economy, 1974, 82, 1063-1093.

Becker, Gary, *Treatise on the Family*, 1991, Cambridge, MA: Harvard University Press.

Benabou, Roland, "Equity and Efficiency in Human Capital Investment: The Local Connection," *Review of Economic Studies*, 1996a, 63, 237-264.

Benabou, Roland, "Heterogeneity, Stratification, and Growth: Macroeconomic Implications of Community Structure and School Finance," *American Economic Review*, 1996b, 86, 584-609.

Bergstrom, Theodore, "A Fresh Look at the Rotten-Kid Theorem - And Other Household Mysteries," *Journal of Political Economy*, 1989, 97, 1138-1159.

Bernheim, Douglas, "A Theory of Conformity," *Journal of Political Economy*, 1994, 102, 841-877.

Berry, Steven, James Levinsohn, and Ariel Pakes, "Automobile Prices in Market Equilibrium," *Econometrica*, 1995, 63, 841-890.

Bikhchandani, Sushil, David Hirschleifer, and Ivo Welch, "A Theory of Fads, Fashion, Custom, and Cultural Change as Informational Cascades," *Journal of Political Economy*, 1992, 100, 992-1026.

Blumstein, Alfred, Jacqueline Cohen, and Daniel Nagin (editors), *Deterrence and Incapacitation: Estimating the Effects of Criminal Sanctions on Crime Rates*, 1978, Washington, DC: National Academy Press.

Borjas, George, "Ethnic Capital and Intergenerational Mobility," *Quarterly Journal of Economics*, 1991, 108, 123-150.

Bowles, Samuel, "'Social Capital' and Community Governance," *Focus*, 1999, 20, 6-10.

Brock, William and Steven Durlauf, "Discrete Choice with Social Interactions," in B. Arthur, S. Durlauf, and D. Lane (editors), *The Economy as an Evolving Complex System II*, 1997, Reading, Mass.: Addison-Wesley.

Brock, William and Steven Durlauf, "Interactions-Based Models," in J. Heckman and E. Leamer (editors), *Handbook of Econometrics*, Volume 5, 2000, Amsterdam: North-Holland.

Cain, Glen, "The Economic Analysis of Labor Market Discrimination: A Survey," in O. Ashenfelter and R. Layard (editors), *Handbook of Labor Economics*, Volume 1, 1986, New York: Elsevier.

Camic, Charles, "The Making of a Method: A Historical Reinterpretation of the Early Parson," *American Sociological Review*, August 1987, 52, 421-439.

Case, Ann, "Spatial Patterns in Household Demand," *Econometrica*, 1991, 59, 953-965.

Case, Ann and Larry Katz, "The Company You Keep: The Effects of Family and Neighborhood on Disadvantaged Youth," Working Paper 3705, National Bureau of Economic Research, 1991.

Coase, Ronald, "The Problem of Social Cost," *Journal of Law and Economics*, 1960, 3, 1-44.

Cole, Harold, George Mailath, and Andrew Postlewaite, "Social Norms, Savings Behavior, and Growth," *Journal of Political Economy*, 1992, 100, 1092-1125.

Coleman, James, *Introduction to Mathematical Sociology*, New York: McMillan.

Coleman, James, "Social Capital in the Creation of Human Capital," *American Journal of Sociology*, 1988, 94, S95-S121.

Coleman, J., E. Campbell, C. Hobson, J. McPartland, A. Mood, F. Weinfeld, and R. York, *Equality of Educational Opportunity*, 1966, Washington DC: U.S. Government Printing Office.

Coleman, James, E. Katz, and H. Menzel, "The Diffusion of an Innovation Among Physicians," *Sociometry*, 1957, 20, 253-270.

Conlisk, John, "Costly Optimizers Versus Cheap Imitators," *Journal of Economic Behavior and Organization*, 1980, 1: 275-293.

Crane, Jonathan, "The Epidemic Theory of Ghettos and Neighborhood Effects on Dropping Out and Teenage Childbearing," *American Journal of Sociology*, 1991, 96, 1226-1259.

Cyert, Richard and Morris DeGroot, "Rational Expectations and Bayesian Analysis," *Journal of Political Economy*, 1974, 82, 521-536.

Dominitz, Jeff and Charles Manski, "Using Expectations Data to Study Subjective Income Expectations," *Journal of the American Statistical Association*, 1997a, 92, 855-867.

Dominitz, Jeff and Charles Manski, "Perceptions of Economic Insecurity: Evidence from the Survey of Economic Expectations," *Public Opinion Quarterly*, 1997b, 61, 261-287.

Dominitz, Jeff and Charles Manski, "The Several Cultures of Research on Subjective Expectations," in R. Willis and J. Smith (editors), *Wealth, Work, and Health*, 1999, Ann Arbor, MI: University of Michigan Press.

Dubin, J. and D. McFadden, "An Econometric Analysis of Residential Electric Appliance Holdings and Consumption," *Econometrica*, 1984, 52, 345-362.

Durlauf, Steven, "The Case 'Against' Social Capital," *Focus*, 1999, 20, 1-5.

Ehrlich, Isaac, "The Deterrent Effect of Capital Punishment: A Question of Life and Death," *American Economic Review*, 1975, 65, 397-417.

Ehrlich, Isaac, "Crime, Punishment, and the Market for Offenses," *The Journal of Economic Perspectives*," Winter 1996, 10, 43-67.

Epple, Dennis and Richard Romano, "Competition Between Private and Public Schools, Vouchers and Peer Group Effects," *American Economic Review*, 1998, 88, 33-63.

Fehr, Ernst and Simon Gächter, "Fairness and Retaliation: The Economics of Reciprocity," *Journal of Economic Perspectives*, 2000, forthcoming.

Fershtman, C. and U. Gneezy, "Trust and Discrimination in a Segmented Society," Department of Economics, Tel-Aviv University, 1998.

Flinn, Christopher and Daniela Del Boca, "Rationalizing Child-Support Decisions," *American Economic Review*, 1995, 85, 1241-1262.

Foster, Andrew and Mark Rosenzweig, "Learning by Doing and Learning from Others: Human Capital and Technical Change in Agriculture," *Journal of Political Economy*, 1995, 103, 1176-1209.

Garfinkel, Irwin, Charles Manski, and Charles Michalopoulos, "Micro-Experiments and Macro Effects," in C. Manski and I. Garfinkel (editors), *Evaluating Welfare and Training Programs*, 1992, Cambridge, MA: Harvard University Press.

Glaeser, Edward, David Laibson, Jose Scheinkman, and Christine Soutter, "What is Social Capital? The Determinants of Trust and Trustworthiness," Working Paper 7216, National Bureau of Economic Research, 1999.

Glaeser, Edward, Bruce Sacerdote, and Jose Scheinkman, "Crime and Social

Interactions," *Quarterly Journal of Economics*, 1996, 111, 507-548.

Goldberger, Arthur and Otis Dudley Duncan (editors), *Structural Equation Models in the Social Sciences*, 1973, New York: Seminar Press.

Granovetter, Mark, "Threshold Models of Collective Behavior," *American Journal of Sociology*, 1979, 83, 1420-1443.

Green, Edward and Robert Porter, "Noncooperative Collusion Under Imperfect Price Information," *Econometrica*, 1984, 52, 87-100.

Guiso, L., T. Jappelli, and D. Terlizzese, "Earnings Uncertainty and Precautionary Saving," *Journal of Monetary Economics*, 1992, 30, 307-337.

Hansen, Lars Peter and James J. Heckman, "The Empirical Foundations of Calibration," *The Journal of Economic Perspectives*, Winter 1996, 10, 87-104.

Hanushek, Eric, "The Evidence on Class Size," Occasional Paper 98-1, Wallis Institute of Political Economy, University of Rochester, 1998.

Harris, Jeffrey E, "Macroexperiments versus Microexperiments for Health Policy," in *Social Experimentation*, J. Hausman and D. Wise (editors), 1985, Chicago: University of Chicago Press.

Hausman, Jerry (editor), *Contingent Valuation; A Critical Assessment*, Amsterdam: North-Holland.

Holland, Paul and Samuel Leinhardt, "A New Method for Detecting Structure in Sociometric Data," *American Journal of Sociology*, 1970, 76, 492-513.

Hurd, Michael and Kathleen McGarry, "Evaluation of Subjective Probabilities of Survival in the Health and Retirement Study," *Journal of Human Resources*, 1995, 30, S268-S292.

Hyman, H., "The Psychology of Status," *Archives of Psychology*, 1942, No.

269.

Jacobs, J., *The Death and Life of Great American Cities*, 1961, New York: Vintage.

Jencks, Christopher and Susan Mayer, "Growing Up in Poor Neighborhoods: How Much Does it Matter?" *Science*, 1989, 243, 1441-1445.

Jones, Steven, *The Economics of Conformism*, 1984, Oxford: Basil Blackwell.

Jovanovic, Boyan, "Observable Implications of Models with Multiple Equilibria," *Econometrica*, 1989, 57, 1431-1438.

Juster, F. Thomas, *Anticipations and Purchases*, Princeton, NJ: Princeton University Press, 1964.

Katona, George, "Federal Reserve Board Committee Reports on Consumer Expectations and Savings Statistics," *Review of Economics and Statistics*, 1957, 39, 40-46.

Kagel, John and Alvin Roth, *Handbook of Experimental Economics*, Princeton, NJ: Princeton University Press, 1995.

Kalai, Ehud and Ehud Lehrer, "Rational Learning Leads to Nash Equilibrium," *Econometrica*, 1993, 61, 1019-1045.

Kandori, Michihiro, "Social Norms and Community Enforcement," *Review of Economic Studies*, 1992, 59, 63-80.

Kydland, Finn E. and Edward C. Prescott, "The Computational Experiment: An Econometric Tool," *The Journal of Economic Perspectives*, Winter 1996, 10, 69-85.

Laumann, Edward and Rebecca Sandefur, "A Paradigm for Social Capital," *Rationality and Society*, 1998, 10, 481-495.

Lazear, Edward, "Economic Imperialism," Working Paper 7300, National Bureau

of Economic Research, 1999a.

Lazear, Edward, "Educational Production," Working Paper 7349, National Bureau of Economic Research, 1999b.

Loury, Glenn, "A Dynamic Theory of Racial Income Differences," in P. Wallace and A. LaMond (editors), *Women, Minorities, and Employment Discrimination*, 1977, Lexington, MA: Lexington Books.

Lucas, Robert, "On The Mechanics of Economic Development," *Journal of Monetary Economics*, 1988, 22, 3-42.

Manski, Charles, "School Choice (Vouchers) and Social Mobility," *Economics of Education Review*, 1992, 11, 351-369.

Manski, Charles, "Adolescent Econometricians: How Do Youth Infer the Returns to Schooling?" in C. Clotfelter and M. Rothschild (editors) *Studies of Supply and Demand in Higher Education*, 1993a, Chicago: University of Chicago Press.

Manski, Charles, "Identification of Endogenous Social Effects: The Reflection Problem," *Review of Economic Studies*, 1993b, 60, 531-542.

Manski, Charles, "Dynamic Choice in Social Settings: Learning from the Experiences of Others," *Journal of Econometrics*, 1993c, 58, 121-136.

Manski, Charles, *Identification Problems in the Social Sciences*, 1995, Cambridge, Mass.: Harvard University Press.

Manski, Charles, "Monotone Treatment Response," *Econometrica*, 1997a, 65, 1311-1334.

Manski, Charles, "Identification of Anonymous Endogenous Interactions," in B. Arthur, S. Durlauf, and D. Lane (editors), *The Economy as an Evolving Complex*

System II, 1997b, Reading, Mass.: Addison-Wesley.

Manski, Charles and John Pepper, "Monotone Instrumental Variables: With an Application to the Returns to Schooling," *Econometrica*, 2000, forthcoming.

Manski, Charles and John Straub, "Worker Perceptions of Job Insecurity in the Mid-1990s: Evidence from the Survey of Economic Expectations," *Journal of Human Resources*, 2000, forthcoming.

Manski, Charles and David Wise, *College Choice in America*, Cambridge, MA: Harvard University Press, 1983.

Marsden, Peter, "Network Data and Measurement," *Annual Review of Sociology*, 1990, 16, 435-463.

Mayer, Susan, "How Much Does a High School's Racial and Socioeconomic Mix Affect Graduation and Teenage Fertility Rates?" in C. Jencks and P. Peterson (editors) *The Urban Underclass*, 1991, Washington, DC: The Brookings Institution.

McElroy, Marjorie, "The Empirical Content of Nash-Bargained Household Behavior," *Journal of Human Resources*, 1990, 25, 559-583.

Merton, Robert, *Social Theory and Social Structure*, 1957, Glencoe: The Free Press.

Moffitt, Robert, "Policy Interventions, Low-level Equilibria, and Social Interactions," Department of Economics, Johns Hopkins University, 1999.

Munshi, Kaivan, "Social Learning and the Speed of Diffusion Across Innovations," 1999, Department of Economics, University of Pennsylvania.

Munshi, Kaivan and Jacques Myaux, "Peer-effects and Individual Decisions: With an Application to the Demographic Transition," 1999, Department of Economics, University of Pennsylvania.

Myerson, Roger, "Nash Equilibrium and the History of Economic Theory," *Journal of Economic Literature*, 1999, 37, 1067-1082.

Nelson, Richard and Edmund Phelps, "Investment in Humans, Technological Diffusion, and Economic Growth," *American Economic Review*, 1966, 56, 69-75.

Pollak, Robert, "Interdependent Preferences," *American Economic Review*, 1976, 78, 745-763.

Portes, Alexandro, "Social Capital: Its Origins and Application in Modern Sociology," *Annual Review of Sociology*, 1998, 1-14.

Putnam, R. "The Prosperous Community: Social Capital and Public Life," *The American Prospect*, 1993, 13, 35-42.

Romer, Paul, "Endogenous Technological Change," *Journal of Political Economy*, 1991, 98, S71-S102.

Rosenzweig, Mark and Kenneth Wolpin, "Parental and Public Transfers to Young Women and Their Children," *American Economic Review*, 1994, 84, 1195-1212.

Savage, Leonard, *The Foundations of Statistics*, 1954, New York: Wiley.

Schelling, Thomas, "Dynamic Models of Segregation," *Journal of Mathematical Sociology*, 1971, 1, 143-186.

Schelling, Thomas, *Micromotives and Macrobehavior*, 1978, New York: Norton.

Sewell, William and J. Armer, "Neighborhood Context and College Plans," *American Sociological Review*, 31, 159-168.

Sims, Christopher A., "Macroeconomics and Methodology," *The Journal of Economic Perspectives*, Winter 1996, 10, 105-120.

Tamer, Elie, "Incomplete Simultaneous Discrete Response Models with Multiple Equilibria," Department of Economics, Princeton University, 1999.

Tiebout, Charles, "A Pure Theory of Local Public Expenditures," *Journal of Political Economy*, 1956, 64, 416-424.

Willis, Robert and Sherwin Rosen, "Education and Self-Selection," *Journal of Political Economy*, 1979, 87, S7-S36.

Wilson, William, *The Truly Disadvantaged: the Inner City, the Underclass, and Public Policy*, Chicago: University of Chicago Press, 1987.

Woittiez, Isolde and Arie Kapteyn, "Social Interactions and Habit Formation in a Model of Female Labour Supply," *Journal of Public Economics*, 1998, 70, 185-205.

Young, Peyton, "The Economics of Convention," *Journal of Economic Perspectives*, 1996, 10, 105-122.

Endnotes

1. See Lazear (1999a) and Myerson (1999) for two recent perspectives on the broadening of economic theory. These authors differ substantially in their emphases but agree that the broadening is well underway.

2. Social interactions in schooling is also a major concern of microeconomic research on schooling. For example, research on the effect of class composition on learning is concerned with the congestion problem that may arise because a classroom of students share a common resource, the teacher, as in Hanushek (1998), or because some students may be disruptive, as in Lazear (1999b). Research on vouchers has been concerned with the effect of these subsidies on class composition, which may affect efficiency of learning, as in Manski (1992) and Epple and Romano (1998).

3. For example, econometric research on discrete choice analysis has enabled empirical researchers to analyze the demand for consumer durables, schooling, and other differentiated products typically purchased in discrete units (for example, Dubin and McFadden, 1984; Manski and Wise, 1983). Discrete choice analysis, research on maximum likelihood estimation of limited dependent variable models, and work on method of moments estimation has combined to enable empirical analysis of firm pricing behavior in oligopolistic markets (Green and Porter, 1984; Berry, Levinsohn, and Pakes, 1995).

4. The empirical literature shows a curious asymmetry in the concern researchers show about the realism of different assumptions. The realism of exclusion restrictions is a recurrent theme, with much criticism befalling the researcher who uses an "invalid" instrumental variable. Yet researchers often regard functional form and distributional assumptions in models of consumer and firm behavior as convenient approximations that do not materially affect inference. In fact, exclusion restrictions, functional form, and distributional assumptions all play essential roles in prevailing approaches to structural econometric analysis. This can be seen by unbundling the various assumptions and determining their identifying power in isolation from one another (Manski 1995, 1997a).

5. For example, Manski (1997a) examines the simultaneity problem under the sole assumption that demand functions slope downward.

Manski and Pepper (2000) examine the inferences that are possible when the classical notion of an instrumental variable is replaced with a weaker but more credible notion of a "monotone instrumental variable."

6. It is often suggested that experimental research would be more credible if the experiments were performed on randomly selected subjects. This can be difficult to achieve because the proper unit of analysis for a study of social interactions is the group, not the individuals that comprise a group. Harris (1985) and Garfinkel et al. (1992) discuss issues that arise in random selection of groups and offer some suggestions for practice.

Occasionally, one can learn something about social interactions from "natural experiments;" that is, naturally occurring group outcomes that can credibly be viewed as arising from randomized experiments. For example, Angrist and Lavy (1999) uses random variation in school class sizes, induced by institutional rules, to examine how class size may affect educational outcomes.

7. Tiebout (1956) made economists sensitive to the idea that residential location decision processes will tend to produce communities made up of families with similar attributes. More generally, decisions of agents to form into groups with similar attributes will tend to yield correlated effects.

8. Juxtaposition of endogenous and contextual interactions reveals a disciplinary contrast between economics and sociology. A central objective of economists has been to understand the feedbacks generated by endogenous interactions; that is, how an agent's behavior varies with the behavior of the group. Some sociologists share this objective. However, modern sociological research has emphasized contextual interactions, where behavior varies with exogenous characteristics of group members. Contextual interactions became an important concern of sociologists in the 1960s, when substantial efforts were made to learn the effects on youth of school and neighborhood environment (for example, Coleman et al., 1966; Sewell and Armer, 1966). The recent resurgence of interest in spatial concepts of the underclass has spawned new empirical studies (for example, Crane, 1991; Mayer, 1991).

9. A recent exception among economists is Woittez and Kapteyn (1998).

10. Let the hypothesized group be all agents with attributes x . Let y denote the behavior or other outcome of interest. Let $E(y^*x)$ be the mean of y in group x . Suppose that a researcher hypothesizes the linear regression model $y = a + bE(y^*x) + u$, with $E(u^*x) = 0$. Taking expectations of both sides yields $E(y^*x)$

= $a + b E(y^*x)$. Hence the linear model holds tautologically with $a = 0$ and $b = 1$.

11. Explanation of imitation as an expectations interaction has been a recurring theme in theoretical research on observational learning. See, for example, Conlisk (1980), Bannerjee (1992), Bickchandani et al. (1992), and Manski (1993c). However, Bernheim (1994) models imitation as a preference interaction. Among empirical researchers, Foster and Rosenzweig (1995), Munshi (1999) and Munshi and Myaux (1999) have been careful to separate imitation based on preference and expectations interactions.

12. There seems to be a similarly narrow basis for the hostility of economists towards elicitation of preferences. In this case, the available negative evidence largely concerns the practice of contingent valuation, where respondents are asked about their willingness to pay for public goods (e.g. Hausman, 1993).