Faith & Economics— Number 42—Fall 2003—Pages 4–16.

Contemporary Philosophy of Science and Neoclassical Economics: An Opportunity for Christian Economists?

JAMES A. MARCUM*

James A. Marcum is Professor of Philosophy, Baylor University (TX).

Physics and neoclassical economics share several interesting features.[1] For example, economists, like physicists, formulate laws to account for observed regularities in the world. Like physicists, economists rely on mathematics to formalize theories that are often not constrained by experimental evidence. Like physicists, economists reduce complex phenomena to basic units, such as the utility of the rational individual, and then explain the complex phenomena in terms of the interaction and aggregation of the basic units. However, one of the most important similarities is that neoclassical economists frequently justify their discipline, particularly their methods, using theories of scientific method devised by philosophers of science, especially by philosophers of physics.[2]

Today, however, there is little consensus among philosophers of science concerning a common scientific method to support scientists in their efforts to do science or to explicate the nature of scientific practice: "the efforts of philosophers of science to formulate theories of method which would be of any assistance to scientists, or which would help explain scientific practice, have been conspicuously unsuccessful" (Gower 1997, p. 248).[3] This situation has at least two important and related consequences for current economic methodology.[4] First, economic methodology need no longer be equated with the methodology of the natural sciences. Second, economists interested in methodological issues can entertain and incorporate principles from other disciplinary fields—such as Christian theology—to develop a robust foundation for economic methodology, rather than one based simply on the notion of utility.[5]

***Author's Note:** *I thank H. Stephen Gardner, Steven L. Green, James Halteman, Joseph A. McKinney, Robert C. Roberts, and especially two anonymous reviewers for comments on an earlier draft of this manuscript. A shorter version of this paper was presented at the 2002 Pruit Memorial Symposium and The Lilly Fellows Program Second National Research Conference, Baylor University. Baylor University supported my research through a Summer Sabbatical award and a University Research Committee grant.*

In this paper, I present the following argument. Since recent developments in science studies, particularly with respect to postmodernism, have reshaped the philosophy of science landscape, economists need no longer pattern their methodology simply on the philosophy of science, particularly on the philosophy of physics. Since economics need no longer be patterned after physics, neoclassical economics need no longer supervene on economic methodology. Consequently, economists can—and should—justify their discipline utilizing resources other than just the philosophy of science and using principles other than simply the utility principle of neoclassical economics.

To defend this argument, I first explore the relationship between the methodologies of the physical sciences and neoclassical economics and assess that relationship exploiting insights from contemporary philosophy of the natural and economic sciences. I also examine and critique the specific metaphysical assumptions and commitments underlying neoclassical economic methodology,[6] using contemporary philosophy of science and Christian theology. I conclude that the current situation provides ample opportunity for Christian economists to participate in the discussion over the development of a robust foundation for economic methodology, using Biblical principles.

Finally, the intent of this paper is not to engage in normative economics or even in descriptive economics but to explore the changing foundation of economic methodology; for the aim of this paper is to motivate a discussion concerning economics that takes into consideration the ethical and moral dimensions of social issues, in terms of raising awareness about the foundation that informs formal economic models and not necessarily in terms of developing these models. Thus, the goal of this paper is not to degrade the power or even to deride the importance of the notion of neoclassical utility for conducting economic research or for justifying economic methodology or to offer an alternate economic methodology; rather, it is to review and discuss the recent changes in economic methodology vis-à-vis contemporary philosophy of science and the op-

portunity these changes present for Christian economists to engage in the discourse over the shifting foundation of economic methodology.[7]

Contemporary Philosophy of Science and Neoclassical Economics

In a well known but controversial book on the relationship between late nineteenth-century economics and physics, Philip Mirowski (1989) charts the historical development of economics vis-a-vis that of physics, especially in terms of the reliance of economics on the physical laws of energy conservation.[8] Specifically, he contends that neoclassical economists patterned the notion of utility after the notion of energy as it arose in late nineteenth-century physics.[9] The development of physics, then, served as a template for the development of economics as a science. Partially by this means, economists laid claim to scientific status for neoclassical economics. Although dependence on the physical sciences assisted economists initially in founding their discipline, it eventually led to serious problems. According to Mirowski, the imitation of economics on nineteenth-century physics generated more heat than light.

Although the justification of neoclassical economics as a science by patterning it after physics is of some historical interest today, twentieth-century neoclassical economists have generally relied on various philosophers of science, especially on the philosophers of physics, to defend the scientific status of economics.[10] In this section, that relationship is explored, beginning with the reliance of economic methodology on positivism and Popper and then on the historiographic revolution of Kuhn and his critic Lakatos, and finally on the sociology of science and postmodernism and on experimentation. Lastly, the metaphysical foundation of neoclassical economics is analyzed in terms of its assumptions and presuppositions, particularly reductionism and materialism.

Positivism and Popper

Although positivism as an ideological movement had its origins in the nineteenth century, its main impact with respect to twentieth-century neoclassical economics was with the development of logical positivism in the early to mid-twentieth century, by an assemblage of scientists, mathematicians, and philosophers, known as the Vienna Circle.[11] Logical positivists, such as Moritz Schlick, Herbert Feigl, and Hans Reichenbach, argued that theoretical statements must be empirically verifiable in order to be meaningful; for non-verifiable statements are metaphysical, i.e., speculative, and thereby meaningless. By the mid-twentieth century, however, problems of induction associated with the verification principle led to the principle's weakening by logical empiricists. Rudolf Carnap (1936), the founder of logical empiricism but also a prominent member of the Vienna Circle, argued that theoretical statements—although not verifiable—could be confirmed, i.e., partial meaning could be assigned to theoretical statements using empirical evidence.[12]

In the first half of the twentieth century, several economists turned to logical positivism/empiricism, in order to justify economics as a science.[13] For example, Terence Hutchinson appropriated the positivist's notion of verification for economic methodology in his 1938 classic on economic theory. Hutchinson claimed that the demarcation of an economic theory as scientific is its ability to be tested empirically: "We suggest that the economic scientist is transgressing the frontier of his subject whenever he resorts to, or advances as possessing some empirical content, propositions which, whatever emotional associations they may arouse, can never conceivably be brought to an intersubjective empirical test" (1938, p. 10). In the mid twentieth century, Fritz Machlup critiqued Hutchinson's positivistic economic methodology as "ultra-empirical" and claimed that "the tests of most of our [economic] theories will be more nearly of the character of *illustrations* than of verifications of the kind possible in relation with repeatable controlled experiments" (1955, p. 19).

Another philosopher of science, Karl Popper, who was a loosely associated with the Vienna Circle, also addressed the debate over the degree of empirical verification or confirmation of a theoretical statement, especially in terms of the demarcation of science from pseudoscience. His solution was falsificationism. Basically, Popper claimed that all theoretical statements must be potentially falsifiable in order to be meaningful or scientific: "it must be possible for an empirical scientific system to be refuted by experience" (1980, p. 41). According to Popper, scientists can neither verify nor confirm a theoretical statement with empirical evidence; they can only corroborate it. His notion of corroboration pertains not to the truth or falsity of a theoretical statement or even to its degree of truth or falsity but to the degree the statement has survived testing. The more tests a theoretical statement has survived, the more corroborated it is.

Popper, who was at the London School of Economics from 1946 to 1969, influenced directly or indirectly numerous economists.[14] For example, Bruce Caldwell (1991) acknowledged that Popper is one of the most popular authorities concerning scientific methodology among economists. However, several economists have noted the unsuitability of Popper's philosophy for justifying the scientific status of neoclassical economics. For instance, Robert Solo argues that although falsificationism is central to changes in economic theory, it "has been rooted in social crisis rather than in any critical discourse internal to the discipline" (1991, p. 41). Again, Debra Redman contends that Popperian falsificationism failed in terms of economic methodology

because economic theories like "physical theories cannot be refuted" (1991, p. 118). And finally, Daniel Hausman (1989) dismisses Popper's model of science, as well as the positivist model, for economics because these models do not accurately reflect the enterprise of the natural sciences more generally.

Beyond Positivism and Popper

Positivism and falsificationism had a profound impact upon economic methodology during the mid twentieth century, although often in chastened or ambiguous forms (Caldwell 1980). For example, Milton Friedman wrote a widely referenced—and certainly controversial—essay on positive economics in the early 1950s. Although he does not cite any philosophers of science in the essay, his analysis of economic methodology mimics the discussion occurring among these philosophers at this period in history.[15] For instance, Friedman claims "positive economics is, or can be, an 'objective' science, in precisely the same sense as any of the physical sciences" (1953, p. 4). This objectivity is made possible, according to Friedman, through the testing of theoretical claims and predictions—a position that weakly but definitely resembles logical positivism/empiricism.[16]

But Friedman avoids the problems associated with logical positivism/empiricism by limiting positive economics on two counts. The first is that for theoretical claims, "Logical completeness and consistency are relevant but play a subsidiary role" (1953, p. 10). The second, and more important, is, "The choice among alternative hypotheses equally consistent with the available evidence must to some extent be arbitrary, though there is general agreement that relevant considerations are suggested by the criteria of simplicity and fruitfulness, themselves notions that defy completely objective specification" (1953, p. 10). With these two limitations, I would argue, Friedman anticipates the work of Thomas Kuhn.[17]

Kuhn (1970) in his influential book, *Structure of Scientific Revolutions*, is credited with the demise of logical positivist/empiricist and Popperian models of the natural sciences. According to Kuhn, science is not exclusively the rational process as championed by the logical positivists/empiricists or Popper. Rather, the scientific enterprise depends not only upon objective features of the natural sciences, such as rationality, but also on its subjective features, such as metaphysical assumptions and commitments. According to Kuhn, a paradigm defines a mature or normal science, by functioning both as an exemplar of previous achievements and as a disciplinary matrix composed of theories, experimental protocols, and metaphysical assumptions and commitments. Importantly, for Kuhn, the scientific community—not nature—is the final arbitrator of scientific knowledge. Scientific revolutions or shifts in incommensurable paradigms best illustrate the scientific community's authority in determining which competing paradigm prevails.[18]

Irme Lakatos (1970) reacted to Kuhn's scientific methodology by calling it "mob psychology" and attempted to rectify what he considered to be the defects of both Popper's and Kuhn's scientific methodologies. According to Lakatos, scientists rally around a hard core of a research programme that is protected from incidental change, by both positive and negative heuristic belts. He argued that scientific change is not the result of "instant rationality", i.e., naïve falsificationism, but generally of protracted rational negotiations within the professional community.[19] In place of naïve falsificationism, Lakatos substituted a "sophisticated" falsificationism that "combines the best elements of voluntarism, pragmatism and the realist theories of empirical growth" (1970, p. 188).

Although some economists have attempted to utilize either Kuhn or Lakatos' scientific methodology for defending neoclassical economic method, success has been minimal.[20] As Hausman notes, Kuhn's and Lakatos' methodologies "have been hard to apply, for they are evasive on questions of theory appraisal, which still interests most of those writing on economic methodology" (1989, p. 124).[21] Caldwell also claims that Kuhn or Lakatos' methodology may disappoint economists, "who would prefer that methodology offer a rigorous, objective, prescriptive framework" (1994, p. 230). Finally, Redman argues that economists have misapplied Kuhn's notion of paradigm and Lakatos' notion of research programme so as to "obscure and clutter [economic] thought" (1991, p. 145).

Sociology of Science and Postmodernism

Within the past several decades, sociologists of science with a postmodern agenda have reshaped much of the discussion on scientific methodology.[22] The agenda of these sociologists is to shake the very foundation of the natural sciences and to question science's privileged position in society in terms of its pronouncements on—or its access to—nature. From their analyses of the natural sciences, these sociologists conclude that scientific knowledge is not discovered but constructed, created, or manufactured—to use but a few of the metaphors used by them. For example, Andrew Ross, a prominent cultural critic of science, claims that "scientific knowledge is not given by the natural world but is produced or constructed through social interactions between/among scientists and their instruments, and that these interactions are mediated by the conceptual apparatuses created in order to frame and interpret the results" (1996, p. 12). Of course, neither scientists nor philosophers of science have remained silent about the claims made by these sociologists and postmodernists concerning the na-

ture of science or scientific knowledge, even though few if any philosophers of science advocate or defend a unique method common to the natural sciences (Gower 1997, Gross *et al.* 1996, Kukla 2000).

This state of affairs for scientific methodology prompted by the sociology of scientific knowledge (SSK) leaves economists, who depend on neoclassical methodology for analyzing and justifying their methods, in a precarious position. In a recent and comprehensive scrutiny of the philosophy of science's role in defending the scientific status of neoclassical economics, Wade Hands (2001) recognizes the burden the turmoil surrounding scientific methodology in terms of SSK places on economists to develop a "new" economic methodology to replace the older one that depends on positivist or Popperian philosophy of science.[23] He argues for an economic methodology that utilizes more diverse sources, including pragmatism, metaphysics, ethics, philosophy of mind, and social studies of knowledge. Hands does not reveal what this economic methodology looks like, although he does discuss possible issues important for its reception by orthodox or heterodox economic methodologists alike (2001, pp. 402–407).

Caldwell (1994) also proposed a "methodological pluralism" for economists interested in methodology, although not as comprehensive as Hands' position. Caldwell's pluralism is based on "a starting assumption that no universally applicable, logically compelling method of theory appraisal exists" (1994, p. 245). According to Caldwell, the pluralistic economic methodologist begins by rationally reconstructing the works of economists, followed by critical analysis of the methodological content of these works. The goal of this analysis is not to discover the "optimal method," but to foster a "critical discourse" in which the strengths and weaknesses of various economic methodologies are brought to light.

Experimentation

Besides the above problems with economic methodology, there is another problem with neoclassical economists patterning economics after physics and defending the scientific status of economics with the philosophy of physics. Physics is considered the premier natural science, in part, because of its reliance on theoretical mathematical formalization. However, this reliance often raises methodological issues, especially in terms of experimental practice. According to Ian Hacking (1983), most philosophers of physics are theory driven in their analyses of the physical sciences and generally ignore the experimental dimensions of those sciences.

Historically, neoclassical economists also stressed theoretical mathematical formulization and often ignored the role of experimentation in the appraisal of economic theory. For example, John Stuart Mill and other Millian economists argued that economics was an *a priori* science and as such did not require experimental evidence. As Hands points out, "Economists start from assumed premises about the behavior of economic agents engaged in activities related to the pursuit of wealth and then deduce various conclusions on the basis of behavior" (2001, p. 22).[24] The reliance of economists on theoretical mathematical formalization, however, raises problems concerning the empirical justification of economic theory vis-a-vis experimentation.

Recently, economists and philosophers of economics have begun to examine the relationship between theory and experiment and the problems it presents for assessing economic theories (Friedman and Sunder 1994, Hey 1991).[25] For example, Francesco Guala and Andrea Salanti (2001) explore the relationship between theory and experimentation by examining what an economic theory is and how it can be tested experimentally.[26] Guala specifically views experiments in economics "as 'mediators' between theoretical models and the target systems whose behaviour they aim at explaining" (1999, p. 41).

Certainly the issues facing the subdiscipline of experimental economics are challenging, but the dividends are too great not to push forward. As John Davis writes concerning the role of experimentation in economic methodology: "we find out how the world works when we engage in experimental activity designed to create special circumstances that trigger mechanisms we suspect operate in the world. What causal mechanisms and structure we attribute to the world depend on what attempts we make at experimental control of the world" (1997, p. 2). Moreover, Vernon Smith—who was awarded a share in the 2002 Nobel Prize in Economics for his work on laboratory experiments in economics—testifies: "experimentation changes the way you think about economics" (1989, p. 152).

Metaphysical Foundation of Neoclassical Economics

Although the logical positivists and empiricists eschewed the metaphysical foundation of the natural sciences, the Oxford philosopher, Robin Collingwood ([1940] 1998), defended its importance, especially in terms of assumptions and presuppositions, for analyzing the natural sciences. Neoclassical economics, like all the sciences, is based on a specific metaphysical foundation that includes certain assumptions and presuppositions. Again, economics has borrowed part of its metaphysical foundation from the physical sciences. This foundation includes such assumptions and presuppositions as reductionism, materialism, determinism, utilitarianism, and naturalism. In this section, reductionism and materialism are briefly examined in terms of their impact on neoclassical economics.[27]

An important philosophical presupposition for neoclas-

sical economists patterning economics after physics is reductionism. As physicists reduce complex natural phenomena to particles and forces, so neoclassical economists reduce complex social phenomena to individual agents and their rational choices.[28] Rational choice theory is the paradigmatic guide for neoclassical economic research: "In mainstream economics, explanations are regarded as 'economic' to the extent that they explain the relevant phenomena in terms of the rational choice of individual economic agents" (Sugden 1991, p. 751).[29] The goal of rational choice theorists, according to one advocate, is to decrease the "domain of social activity that cannot be accounted for by the theory" (Coleman 1990, p. 18). In other words, not only economic behavior but also social behavior is to be explained by rational choice theory (Hirshleifer 1985).

Some critics argue that the use of reductionism in economics, especially in terms of rational choice, is unable to account satisfactorily for complex social phenomena, such as organizational behavior. For example, Mary Zey contends: rational choice theory "claims to be able to explain noneconomic social phenomena but does not adequately address issues such as power, trust, communication, and solidarity. This is a formal, rigid theory that achieves a high degree of predictability because it is self-referential and brushes aside instances of nonrational behavior, such as altruism" (1998, p. 11). Although reductionism is a valuable methodological principle for conducting scientific research, it is of limited value for appropriating economic research and experimentation to complex social issues.[30]

Another important philosophical presupposition for neoclassical economics is materialism. Just as physicists examine and study a physical world composed of material entities such as atoms and forces, so economists examine and study an economic world composed of material goods and services. The notion of economic materialism is defined by the goods and services society produces for consumption by individuals who exhibit specific preferences (tastes) in terms of their utility functions. In an analysis of North American materialism and consumerism, James Twitchell encapsulates the notion of economic materialism rather succinctly: "Things 'R' Us" (1999, p. 286).

Although materialism is an important assumption for conducting economic analyses, issues have been raised whether we are simply materialistic beings, *Homo economicus*—especially the subspecies *Homo economicus marxus*. For example, Ludwig von Mises in his critique of Marx's dialectical materialism concludes: "Any doctrine that teaches that some real or external forces write their own story in the human mind and thus tries to reduce the human mind to an apparatus that transforms reality into ideas in the way in which the digestive organs assimilate food is at a loss to distinguish between what is true and what is not" (1962, pp. 32–33).

An Opportunity for Christian Economists?

From a Christian theological perspective there are also several problems with patterning neoclassical economics after physics, especially problems with its metaphysical foundation, including its assumptions and presuppositions, and with the ethical and moral commitments of this foundation. Whereas the physical world is not encumbered with moral issues since it is given, the social world is charged with them since we can choose which social world to live in based on personal or social values (Boulding 1969).[31] For example, some Christians view North American materialism as a moral problem: "materialism is troublesome not only because it threatens our social health, but also because it opposes our deepest values" (Wuthnow, 1995, p. 4). It is those values that define us, not the things we consume.[32]

Besides the problems associated with materialism, reductionism in terms of rational choice theory is also problematic, especially for the Christian: reducing the social world to individual agents and their rational choices presents too simplistic a picture of that world, especially of human moral behavior. The 1992 Nobel Prize laureate in economics, Gary Becker, has attempted "to pry economists away from narrow assumptions about self-interest. Behavior is driven by a much richer set of values and preferences" (1993, p. 385).[33] People frequently make choices based on personal or cultural values that may not be analyzable in rational-choice terms alone.[34] Often human—especially moral—behavior outstrips rational capacities. In his letter to the Romans (7:7–25), for example, St. Paul struggles with knowing the good but being morally impotent to choose or do it. How can a reductionistic social science as neoclassical economics model such apparently nonrational behavior adequately?[35]

Also related to reductionism is the reliance of neoclassical economic methodology on individualism or atomism (Arrow 1994). According to this position, "a social grouping has no reality or substance beyond that of the individual persons comprising it: statements about a society are seen as reducible to statements about its component individuals" (Cramp, 1983, section III, p. 4). Amitai Etzioni (1988) claims the reliance of neoclassical economics on the individual as a rational choice agent cannot adequately or ultimately account for the choices people make, even economic choices. He goes on to argue that economic methodology must include a "morality utility," as well as a social collective, in the economic decision process. Moreover, some Christian economists fear that educating people with the view of human nature as utility maximization may promote socially unacceptable behavior: "By teaching

people the utilitarian ideology of neoclassical economics, economists encourage the very kind of self-interested, greedy behavior that is inconsistent with the demands of the Christian life and destructive to the economy itself" (Tiemstra 1993, pp. 232–233).

Besides materialism, reductionism, and individualism there are problems with other metaphysical assumptions and commitments, including naturalism, utilitarianism, and determinism, associated with an economics patterned after physics (Hoksbergen 1994). For example, physics and the other natural sciences rely methodologically on naturalism. Certainly naturalism is an appropriate methodological constraint for economics; however, there is a danger here, as evident from the natural sciences such as biology. For example, Francis Crick goes well beyond a parsimonious interpretation of the empirical data obtained from neurophysiological experimentation when he asserts: "You, your joys and your sorrows, your memories and your ambitions, your sense of personal identity and free will, are in fact no more than the behavior of a vast assembly of nerve cells and their associated molecules" (1994, p. 3). Physicists and the other natural scientists sometimes stray to a position of metaphysical naturalism, which they attempt to defend imprudently as an empirically justified position. Naturalism, although an attractive methodological tool, truncates the social world to such an extent—if taken as a metaphysical assumption or commitment—so as to make neoclassical economics irrelevant for explaining human behavior.

Roland Hoksbergen asserts that these metaphysical assumptions and commitments of "neoclassical and other economics traditions violate basic Christian beliefs at their very core" (1994, p. 135). Along with John Tiemstra (1993) and others (Grudem 1989, Hay 1989, Pierard 1989, Tiemstra et al. 1990), he recommends that these commitments be replaced or tempered by Biblical principles such as stewardship or justice. Only then can Christian economics be truly developed. However, there is a problem of how to interpret appropriately the Biblical passages concerned with principles that are relevant to economic issues. For example, the exchange between Stephen Mott (1987) and Udo Middelmann (1987) illustrates the difficulties surrounding the interpretation of Biblical passages for defining the role of justice in economic distribution.[36] Furthermore, as Arnold McKee (1987) argues, the Bible cannot give us the details to conduct economic analysis, although its principles can influence that analysis in terms of its moral or ethical nature.

Lunn and Klay's Defense of Neoclassical Economics

In defense of neoclassical economics, John Lunn and Robin Klay critique the positions of both Hoksbergen and Tiemstra, among others, claiming that neoclassical economics has been very successful and that it is not meant to account for all of human behavior but only for "the ordinary business of life" (1994, p. 148). For them, rational choice theory is a simplifying assumption of economic methodology and nothing more. Lunn and Klay go on to argue: "The roots and language of neoclassical economics stem from utilitarianism, but the substance has changed . . . The term utility, [quoting from Armen Alchian and William Allen's 1972 textbook *University Economics*] ". . . is now simply an *indicator* for ranking options in accord with one's preferences" (1994, p. 156). Finally, they question whether the Biblical principle of stewardship can support and sustain economic research. Their critique is important and insightful and needs to be addressed.

No one would argue with Lunn and Klay's claim that rational choice theory is a simplifying—and very fruitful—assumption in neoclassical economics. However, many critics of rational choice theory claim that the assumption simplifies human behavior to such an extent as to make the results of any analysis based on the assumption suspect. For example, Paul Lewis critiques, using the notion of critical realism (CR), the "impoverished notion of choice" in neoclassical economics: "The deductivist scheme of explanation constitutes a Procrustean bed that excludes the essence of choice, namely people's 'capacity to do otherwise.' CR contends that it is difficult to see how models which are so unrealistic that they ignore a fundamental feature of the socio-economic world like people's freedom of choice can possibly be of use in understanding that world" (2003, p. 60).[37] Moreover, scholars in other disciplines have tried to apply rational choice theory to research in their respective disciplines, with controversial results. For example, Donald Green and Ian Shapiro (1994) argue that rational choice theory is inadequate for the political sciences.[38]

With respect to Lunn and Klay's assertion that neoclassical theory is concerned only with "the ordinary business of life," one is perplexed as to what that life specifically involves. It would seem that "the ordinary business of life" is a rather vague expression that could cover almost any situation in life, under any given circumstances. Unfortunately, the authors do not give us a clear definition for this phrase.[39] In addition, Lunn and Klay's definition of utility certainly captures the broad sense of the term; however, it is not the only definition of the notion found in economic textbooks. For example, in the recent edition of Gregory Mankiw's popular introductory economics textbook, the term utility is defined in its precise neoclassical sense: "the level of happiness or satisfaction that a person receives from his or her circumstances" (2001, p. 447).

Biblical Principles and Economic Methodology

Lunn and Klay also raised concern over the ability of

Biblical principles, such as stewardship, to sustain economic research, compared to the notion of utility. As several Christian economists have pointed out, the neoclassical rational agent who maximizes utility is often divergent from the Christian's call to stewardship. For example, Tiemstra claims: "The neoclassical account of self-interested, gain-seeking individuals is incapable of describing the behavior of Christians who are trying to live according to the stewardship principle" (1993, p. 232). Moreover, A.B. Cramp defines the "norm" of stewardship in Goudzwaardian terms as "the (socially) rewarding disposition of economic resources entrusted to man's care" (1983, section VI, p. 11). He goes on to contrast an economics based on this norm of stewardship to that of neoclassical economics based on utility, using profit and economic growth as case studies. Furthermore, the contrast between the two systems is well articulated by Cramp: "Economic life is intended to be, not the sphere of self-centered exchanges by hedonistic maximizers, but 'the expression of human solidarity and a sign of spiritual communion'" (1983, section VI, p. 10).[40]

Whereas utilitarianism is centered on maximizing an individual's utility, Christian stewardship is centered on maximizing God's utility.[41] For the basis of Christian stewardship is the doctrine of creation, in that God entrusts us with the responsibility for taking care of creation and our fellow human beings who are made is God's image.[42] Rather than maximizing our individual utility, in terms of pleasure, we are called to maximize our and other's well-being, which requires a more comprehensive picture of a person. Well-being has been generally overlooked in discussions concerning the role of Biblical principles in reshaping the foundation of economic methodology. I believe that as a Biblical principle, it can contribute significantly to the discussion over reframing that foundation.

As a Biblical principle, well-being represents more than just the welfare of the individual or even of the society. Welfare, especially the modern notion of it, is generally concerned with an individual's or a society's material prosperity (Hicks 1975). Moreover, it is also dependent on the idea of scarcity associated with neoclassical economics.[43] The Biblical principle of well-being, however, depends on meeting human needs sufficiently through God's abundance.[44] Rather than being a reductionist idea like material welfare, well-being is holistic. It involves not only the material needs of human flourishing but also the social, cultural, and religious needs. In addition, well-being is closely related to God's shalom.[45] Both God's abundance and shalom empower us to create wealth that endows society with the ability to care for its misfortunate members and to restore their well-being. Importantly, the purpose of this empowerment is not to enslave these misfortunate members or to reduce them to monetary figures.[46]

The current disarray in contemporary philosophy of science and in neoclassical economic methodology provides ample opportunity for Christian economists to participate in the discourse over the shifting foundation of economic methodology. Some Christian economists have already engaged in this discourse by proposing Biblical principles such as stewardship to found a Christian economics. However, the impact of these economists to date has been negligible. Formal economic modeling and the testing of these models are difficult enough, even with simplifying assumptions like utility (Cox 1997). The use of Biblical principles like stewardship as assumptions makes economic modeling and testing even more difficult, if not impossible, at this time. Moreover, Christian economists must be cautious in interjecting Biblical principles wholesale to discussions over the foundation of economic methodology. First, as just noted, most Biblical principles are not easily or directly applicable to economic methodology, especially in developing formal economic models. Second, although critical choice theory has numerous problems, it still serves—as Lunn and Klay argue—the economic community well. The challenge for Christian economists is how best to participate within the current discussion over the shifting foundation of economic methodology with grace, wisdom, patience, and above all charity.

Conclusion

Traditionally, neoclassical economics is patterned after physics in two senses. The first sense is a patterning in which the economic sciences are considered analogous to the physical sciences. This involves a descriptive comparison of the two sciences. However, current physics has advanced significantly since the nineteenth century. According to Mirowski (1989), such a patterning has produced problems for today's economic sciences. The second sense of patterning is normative, i.e., the economic sciences should be like the physical sciences. Although philosophy of physics is used to defend this patterning, it can no longer sustain the maturation of economics as a discipline. According to Hands (2001), economists must develop their own metaphors and methodology to advance and justify economics as a science.

Until recently, philosophers of physics dictated the methodological agenda for the other natural sciences. Today philosophers have developed robust methodologies for these other natural sciences, in which issues specific to these sciences are addressed.[47] There are certainly ample differences between economics and physics and sufficiently unique issues in economics and its practice such that economists can develop an economic methodology apart from the neoclassical economic methodology that depends on the philosophy of physics. Hands (2001) has challenged econo-

mists to develop a foundation for economic methodology not grounded on the methodology of logical positivism/empiricism or Popperianism or even on the methodology of Kuhn or Lakatos but on a more pluralistic postmodern approach to science.

Certainly this situation in contemporary economic methodology and philosophy of science opens the door for Christian economists to introduce Biblical principles, rather than just utility or rational choice, into the discourse over the foundation of economic methodology. Specifically, the challenge for Christian economists is to incorporate Biblical principles, such as stewardship, justice, and well-being, into the discussion over the foundation for economic methodology—even though the benefits may not be immediately forthcoming.[48] Ultimately, these principles may serve as a source for developing economic models and attendant methodology to justify those models. For human nature or behavior, economic or otherwise, cannot be reduced to a single notion such as utility. Rather, economics is a science that complements the other social sciences, as well as the natural sciences, in giving us a more comprehensive picture of our world.[49]

Endnotes

1 Neoclassical economics is not so much a single school of economic thought as it is a collection of subschools that arose during the marginalist revolution, in the late nineteenth century. These subschools, however, do share several characteristics, one of which is the reduction of market phenomena to individual choice that maximizes the individual's utility (Mills 2002, Screpanti and Zamagni 1993). Moreover, neoclassical economics is often combined with other economic theories, such as Keynesian macroeconomics, to form a synthesis or "mainstream" economics (Dow 1997).

2 For recent discussions of economic methodology vis-a-vis philosophy of science, see Blaug (1992), Caldwell (1994), Hands (2001), Redman (1991), and Solo (1991). Traditionally, philosophy of science has been closely identified with the philosophy of physics, especially the ontological and epistemological issues in the physical sciences (Hacking 1983). Moreover, one of the more important issues in traditional philosophy of physics is the demarcation of science from pseudoscience (Popper 1980).

3 Even the view that the development of the natural sciences since the seventeenth century is due to a specific or special method has been rejected. For example, John Schuster claims that it is debatable "whether the origin and development of modern science can be explained by means of the emergence, refinement and application of 'the scientific method'" (1990, p. 221).

4 It is critical to distinguish between method, the actual practices associated with a discipline, and methodology, the study or analysis of that method. For an insightful examination of the distinction, see Machlup (1978).

5 There is no strong consensus among economists over the notion of utility. Briefly, it often refers to the pleasure obtained from an object, for example, and not to the usefulness of the object as a property of the object *per se*. The notion is important for economists in terms of explicating economic value under various conditions (Fishburn 2001).

6 Neoclassical methodology is founded on the notion of utility and on rational choice theory (Hands 2001).

7 Although many economists are unconcerned about or even hostile to methodological issues (Lawson 1994), the field of economic methodology has enjoyed relative success as measured by the number of books and articles published on the topic within the past several decades: "Since the 1970s, interest in economic methodology has grown dramatically, to the extent that it is now possible to view methodology as a clearly identifiable subdiscipline within economics" (Backhouse 1994, p. 1). Moreover, the subdiscipline has its own journal, *Journal of Economic Methodology*, begun in 1994.

8 For discussion and critique of Mirowski's thesis, see, e.g., de Marchi (1993).

9 As energy is a force that gives rise to physical work or motion, similarly utility is a force that gives rise to individual choice or decision. According to Mirowski, the reliance of neoclassical economics on energetics was forgotten by the 1930s (1989, pp. 265–270).

10 The status of economics as a science is a point of debate. For example, Deirdre McCloskey (1985, 1994) claims that economists are dependent on the use of rhetorical devices, such as stories and metaphors, in economic methodology. Margaret Schabus, in a similar vein, argues that economic methodology is comparable not to the scientific method but to the search for "structured stories" by historians "to explain social events as the result of human agency" (1986, p. 304).

11 For a concise history of the Vienna Circle, see Feigl (1969).

12 Essentially, the problem plaguing the verification principle was induction. Even though empirical evidence could be marshaled to verify a theoretical statement, there is always a possibility that additional evidence may no longer verify the statement. The same problem plagued even Carnap's weaker confirmation principle. For further discussion of this issue, see Gower (1997).

13 For a discussion of economists' utilization of logical positivism/empiricism, see Caldwell (1994).

14 For a defense of a modified version of Popperian falsificationism for economic methodology, see Blaug (1992).

15 Commentators have frequently attributed to Friedman a falsificationist position, based on his claim: "Factual evidence can never prove a hypothesis; it can only fail to disprove it, which is what we generally mean when we say, somewhat inexactly, that the hypothesis has been confirmed by experience" (Friedman, 1953, p. 9). Friedman's position does resemble Popper's notion of falsificationism, but the context in which Friedman makes this comment is not to demarcate science from pseudoscience (Popper's main concern) but to chasten a naïve understanding of the relationship between empirical evidence and theory choice. For further discussion of Friedman's relationship to Popper's methodology, see Frazer and Boland (1983).

16 Friedman's methodology has been the focus of much debate. For a discussion of this literature, see, e.g., Boland (1979).

17 For example, Friedman's second limitation resembles Kuhn's assertion that two scientists can choose different theories even though the objective criteria, such as simplicity and fruitfulness, are comparable or similar. Kuhn (1977) argued that such criteria may also be applied to theory choice based on subjective differences between the two scientists.

18 According to Kuhn (1970) shifts in paradigms are occasioned by anomalies, i.e., results that do not fit within the prevailing paradigm, even though the scientific community often ignores or depreciates anomalous results (Cremo and Thompson 1998).

19 Willard Quine (1974) identified another problem with Popper's falsificationism. Theories never stand in isolation from one another but are part of a "web" of theories. Altering another theory within the web that is not under direct test may accommodate the falsifying evidence. See Cross (1982), for application of Quine's holism—as part of the Duhem-Quine thesis—to economic theory appraisal.

20 For an example of an appropriation of Lakatos to economic methodology but of a rejection of Kuhn, see Blaug (1975).

21 Theory appraisal is an important issue for economists (de Marchi and Blaug 1991), and Kuhn (1970), for example, offers no criteria to account for the role of anomalies in paradigm shifts. Richard Thaler's work on anomalous behavior that defies neoclassical economic predictions illustrates the problems associated with economic theory appraisal. He challenges economists to utilize such anomalies to develop better and richer economic theories; for Thaler realizes that their "job is much harder than we have previously thought. Writing down a model of rational behavior and turning the crank may not be enough" (1991, p. 198).

22 For further discussion of the relationship between the philosophy of science and sociology of science influenced by postmodernism, see, e.g., Fuller (1993).

23 For example, Hands claims: "if one takes the job of economic methodology to be its traditional normative task of finding the proper economic method—the search for a relatively small set of epistemically justified rules governing the conduct of proper scientific inquiry in economics—then *SSK tells us to give up on such methodology*" (2001, p. 208).

24 Vernon Smith comments on this situation, especially in terms of the education of economists: "the training of economists conditions us to think of economics as an *a priori* science, and not as an observational science in which the interplay between theory and observation is paramount" (1989, p. 151).

25 Although experimentation in economics dates from Bernoulli in 1738, the current interest in economic experimentation dates from the mid twentieth century (Roth 1988).

26 Earlier, Smith (1989) also addressed the same issues in terms of environment, institutions, and behavior. Later, Smith (1994) discussed reasons other than theory testing for why economists engage in experimentation.

27 Naturalism and utilitarianism are discussed in the next section. As for determinism, briefly, physicists assume that specific causes, especially in terms of a causal chain, determine the events of natural phenomena. Likewise, neoclassical economists traditionally assume that an individual's utility or preference within a given framework determines economic choices (Rabin 1998).

28 Reductionism in economics may also pertain to market exchanges. For example, Alan Coddington, in a discussion of the first principles in Keynesian economics, claims that reductionism can be defined as "the reduction of market phenomena to (stylized) individual choices" (1976, p. 1258).

29 Sugden concludes his article, however, with the claim that rational choice "foundations are less secure than we thought, and that they need to be examined and perhaps rebuilt. Economic theorists may have to become as much philosophers as mathematicians" (1991, p. 783).

30 Roth makes a similar point: "Almost simultaneously with the rise of expected utility theory to pride of place among economists' models of individual choice behaviour, early experiments began to establish that there are at least some situations in which a substantial percentage of experimental subjects can be observed to exhibit patterns of choice that violate predictions of the theory" (1988, p. 1010).

31 Although the natural world may be a given for the natural sciences, we do choose which part of it to investigate.

32 Psychologist Tim Kasser demonstrates that replacement of moral values with materialistic ones leads to a higher risk of unhappiness and erodes our sense of well-being: "rather than providing paths to freedom and autonomy, people feel chained, pressured, and con-

trolled when they focus on materialistic values" (2002, p. 86).

33 It must be noted that Becker does not advocate dismissing the rational choice model; for it "provides the most promising basis presently available for a unified approach to the analysis of the social world by scholars from different social sciences" (1993, p. 403).

34 Andrew Henley (1987) also criticizes neoclassical economics along similar lines, claiming it is founded on the "positivist fallacy," i.e., sciences like economics are value free.

35 James Coleman addresses this question from a rational choice perspective: "much of what is ordinarily described as nonrational or irrational is merely so because the observers have not discovered the point of view of the actor, from which the action *is* rational" (1990, p. 18). Although Coleman's defense is certainly true at times, there are times when actors consciously recognize the nonrational or irrational nature of their behavior, as in the case of St. Paul.

36 For further discussions concerning problems associated with Biblical hermeneutics and economics, see Mott (1989), Tiemstra *et al.* (1990), and Wolterstorff (1987).

37 Similarly, Robert Frank (1985, p. vi) claims: "we [economists] have too often neglected fundamental elements of human nature in our study of the ways people behave." He goes on to demonstrate that the concern of both individuals and corporations over their position "on the economic totem pole" influences their economic behavior. However, care must be exercised not to make economics account for all of human behavior, for such a broad notion may not be specific enough to be predictive.

38 For reactions to Green and Shapiro, see Friedman (1996).

39 Interestingly, Lunn and Klay take the phrase, "ordinary business of life," from Alfred Marshall's textbook on economics. Marshall uses the phrase to define economics in terms of "that part of individual and social action which is most closely connected with the attainment and with the use of the material requisites of wellbeing" (1920, p. 1). Roger Backhouse, in his history of economics entitled *The Ordinary Business of Life*, admits that the Marshallian phrase is "imprecise" and needs to be made "more precise" (2002, p. 4).

40 For discussions on the Biblical principle of stewardship for reforming economic methodology, see, e.g., Hay (1989), Klay (1986), and Tiemstra *et al.* (1990).

41 Certainly God draws great delight in our responsible stewardship, and, in that sense, God's utility is maximized. Obviously, God's utility is not the same as neoclassical economic utility. For example, Jonathan Leightner (2003) cautions that God does not maximize (neoclassical economic) utility, since God enters voluntarily into human suffering.

42 Another important basis for Christian stewardship in terms of economics is the Fall. See, e.g., Griffiths (1982) and Tiemstra *et al.* (1990).

43 Stewardship may also be aligned with the idea of scarcity. For example, Robin Klay notes correctly that stewardship is required to make good decisions concerning limited resources. However, one must be cautious not to loose faith that God can provide from abundant resources even when we must make decisions that are based on our limitations or limited resources. For example, Klay recognizes "the all-too-human pain of knowing that choosing to spend one dollar or one hour for the sake of Alice implies the willing sacrifice of an opportunity to do the same for John" (1986, p. 10). Besides the pain, there must also certainly be peace and joy in knowing that God will raise up someone else for John's well-being.

44 Arnold McKee also questions the validity of scarcity, even from a material perspective: "taken in an absolute and overall sense, the resources of the world are not scarce at all" (1987, p. 130).

45 Shalom within the Bible refers to more than peace as mental tranquility but to the completeness or wholeness of one's life. For additional discussion of shalom vis-à-vis well-being, see Tiemstra *et al.* (1990), pp. 98–103.

46 A brief examination of the Good Samaritan parable (Luke 10:25–37) illustrates some of the salient features of the Biblical principle of well-being, including abundance, caring, empowering, and restoring. First, the parable is preceded by the commandment to love God and neighbor. This context is important for framing any discussion of the parable, especially its economic implications, for love is the ultimate Biblical principle that guides divine and human action—whether economic or otherwise. The Good Samaritan acts out of compassion for the half-dead victim of this brutal robbery. He cares deeply for the victim's plight and responds generously with both his time and material resources. Not only does he pay for the victim's immediate needs but also promises payment for any future cost of restoring the victim's well-being. Notice, however, that the Good Samaritan's generosity reflects an abundance that meets the victim's needs sufficiently but not excessively. Finally, the Good Samaritan has empowered others, such as the Innkeeper, in the task of restoring the victim's well-being.

47 For example, biological evolution has become an industry in the philosophy of science (Depew and Weber 1989). Economists have also used the evolutionary sciences to pattern and justify their methodology (Boulding 1981, Hodgson 1993, Reijnders 1997).

48 Of course, another challenge is the tremendous diversity of Christian confessions, which can influence the specific development of a foundation for economic methodology (Webb 1994).

49 Tiemstra *et al.* come to a similar conclusion, claiming that the scope of economics has been constrained too

narrowly thereby "ignoring the close relationships between economic life and the larger context of human concerns" (1990, p. 65).

References

Arrow, K. J. 1994. "Methodological Individualism and Social Knowledge." *American Economic Review*. 84, pp. 1–9.

Backhouse, R. E., ed. 1994. *New Directions in Economic Methodology*. London: Routledge,

_____. 2002. *The Ordinary Business of Life: A History of Economics from the Ancient World* to *the Twenty-First Century*. Princeton: Princeton University Press.

Becker, G. S. 1993. "The Economic Way of Looking at Behavior." *Journal of Political Economy*. 101, pp. 385–409.

Blaug, M. 1975. "Kuhn versus Lakatos, or Paradigms versus Research Programmes in the History of Economics." *History of Political Economy*. 7, pp. 399–433.

_____. 1992. *The Methodology of Economics: Or How Economists Explain*. 2nd edition. Cambridge: Cambridge University Press.

Boland, L. A. 1979. "A Critique of Friedman's Critics." *Journal of Economic Literature*. 17, pp. 503–522.

Boulding, K. E. 1969. "Economics as a Moral Science." *American Economic Review*. 59, pp. 1–12.

_____. 1981. *Evolutionary Economics*. London: Sage.

Caldwell, B. J. 1980. "Positivist Philosophy of Science and the Methodology of Economics." *Journal of Economic Issues*. 14, pp. 53–76.

_____. 1991. "Clarifying Popper." *Journal of Economic Literature*. 29, pp. 1–33.

_____. 1994. *Beyond Positivism: Economic Methodology in the Twentieth Century*. Revised edition. New York: Routledge.

Carnap, R. 1936. "Testability and Meaning." *Philosophy of Science*. 3, pp. 419–471.

Coddington, A. 1976. "Keynesian Economics: The Search for First Principles." *Journal of Economic Literature*. 14, pp. 1258–1273.

Coleman, J. 1990. *Foundations of Social Theory*. Cambridge, MA: Belknap Press.

Collingwood, R. G. [1940] 1998. *An Essay on Metaphysics*. Revised edition. Oxford: Clarendon Press.

Cox, J. C. 1997. "On Testing the Utility Hypothesis." *Economic Journal*. 107, pp. 1054–1078.

Cramp, A. B. 1983. *Economics in Christian Perspective: A Sketch-Map*. Toronto: Institute for Christian Studies.

Cremo, M. A., and R. L. Thompson. 1993. *Forbidden Archeology: The Hidden History of the Human Race*. San Diego: Bhaktivedanta Institute.

Crick, F. H. C. 1994. *The Astonishing Hypothesis: The Scientific Search for the Soul*. New York: Simon & Schuster.

Cross, R. 1982. "The Duhem-Quine Thesis, Lakatos and the Appraisal of Theories in Macroeconomics." *Economic Journal*. 92, pp. 320–340.

Davis, J. 1997. "The Economics of Scientific Knowledge," posted on the History of Economics web site at: http://www.eh.net/HE/hes_list/Editorials/jdavis.php.

De Marchi, N., ed. 1993. *Non-Natural Social Science: Reflecting on the Enterprise of More Heat than Light*. Durham: Duke University Press.

_____ and M. Blaug, eds. 1991. *Appraising Economic Theories: Studies in the Methodology of Research Programs*. Hants, UK: Edward Elgar.

Depew, D. J., and B. H. Weber, eds. 1989. *Evolution at a Crossroads: The New Biology and the New Philosophy of Science*. Cambridge: MIT Press.

Dow, S. C. 1997. "Mainstream Economic Methodology." *Cambridge Journal of Economics*. 21, pp. 73–93.

Etzioni, A. 1988. *The Moral Dimension: Toward a New Economics*. New York: Free Press.

Feigl, H. 1969. "The Origin and Spirit of Logical Positivism." In *The Legacy of Logical Positivism*, edited by P. Achinstein and S. F. Barker. Baltimore: The Johns Hopkins University Press.

Fishburn, P. 2001. "Utility and Subjective Probability: Contemporary Theories." In *International Encyclopedia of the Social and Behavior Sciences*, Vol. 24, edited by N. J. Smelser and P. B. Baltes. New York: Elsevier.

Frank, R. H. 1985. *Choosing the Right Pond: Human Behavior and the Quest for Status*. New York: Oxford University Press.

Frazer, W. J., Jr., and L. A. Boland. 1983. "An Essay on the Foundations of Friedman's Methodology." *American Economic Review*. 73, pp. 129–144.

Friedman, D., and S. Sunder. 1994. *Experimental Methods: A Primer for Economists*. Cambridge: Cambridge University Press.

Friedman, J., ed. 1996. *The Rational Choice Controversy: Economic Models of Politics Reconsidered*. New Haven: Yale University Press.

Friedman, M. 1953. "Essay on the Methodology of Positive Economics." In *Essays in Positive Economics*. Chicago: University of Chicago Press.

Fuller, S. 1993. *Philosophy of Science and Its Discontents*. 2nd ed. New York: Guilford Press.

Gower, B. 1997. *Scientific Method: An Historical and Philosophical Introduction*. New York: Routledge.

Green, D. P., and I. Shapiro. 1994. *Pathologies of Rational Choice Theory: A Critique of Applications in Political Science*. New Haven: Yale University Press.

Griffiths, B. 1982. *Morality and the Market Place*. London: Hodder and Stoughton.

Gross, P. R., M. Levitt, and M. W. Lewis, eds. 1996. *The Flight From Science and Reason*. New York: New York Academy of Sciences.

Grudem, W. A. 1989. "How an Economic System can be

Compatible with Scripture." In *Biblical Principles and Economics: The Foundations*, edited by R. C. Chewning. Colorado Springs: Navpress.

Guala, F. 1999. *Economics and the Laboratory: Some Philosophical and Methodological Problems Facing Experimental Economics*. Doctoral dissertation: London School of Economics.

_____ **and A. Salanti.** 2001. "Theory, Experiments, and Explanations in Economics." *Revue Internationale de Philosophie*. 217, pp. 327–349.

Hacking, I. 1983. *Representing and Intervening: Introductory Topics in the Philosophy of Natural Science*. Cambridge: Cambridge University Press.

Hands, D. W. 2001. *Reflection Without Rules: Economic Methodology and Contemporary Science Theory*. Cambridge: Cambridge University Press.

Hausman, D. M. 1989. "Economic Methodology in a Nutshell." *Journal of Economic Perspectives*. 3, pp. 115–127.

Hay, D. A. 1989. *Economics Today: A Christian Critique*. Grand Rapids, MI: Intervarsity Press.

Henley, A. 1987. "Economic Orthodoxy and the Free Market System: A Christian Critique." *International Review of Economics and Ethics*. 2, pp. 56–66.

Hey, J. D. 1991. *Experiments in Economics*. Oxford: Blackwell.

Hicks, J. R. 1975. "The Scope and Status of Welfare Economics." *Oxford Economic Papers*. 27, pp. 307–326.

Hirshleifer, J. 1985. "The Expanding Domain of Economics." *American Economic Review*. 75, pp. 53–68.

Hodgson, G. M. 1993. *Economics and Evolution: Bringing Life Back into Economics*. Ann Arbor, MI: University of Michigan Press.

Hoksbergen, R. 1994. "Is There a Christian Economics? Some Thoughts in Light of the Rise of Postmodernism." *Christian Scholar's Review*. 24, pp. 126–142.

Hutchinson, T. W. 1938. *The Significance and Basic Postulates of Economic Theory*. London: Macmillan.

Kasser, T. 2002. *The High Price of Materialism*. Cambridge: MIT Press.

Klay, R. K. 1986. *Counting the Cost: The Economics of Christian Stewardship*. Grand Rapids, MI: Eerdmans Publishing Co.

Kuhn, T. S. 1970. *Structure of Scientific Revolutions*. 2nd ed. Chicago: University of Chicago Press.

_____**.** 1977. "Objectivity, Value Judgment, and Theory Choice." In *The Essential Tension: Selected Studies in Scientific Tradition and Change*. Chicago: University of Chicago Press.

Kukla, A. 2000. *Social Constructivism and the Philosophy of Science*. New York: Routledge.

Lakatos, I. 1970. "Falsificationism and the Methodology of Scientific Research Programmes." In *Criticism and the Growth of Knowledge*, edited by I. Lakatos and A. Musgrave. Cambridge: Cambridge University Press.

Lawson, T. 1994. "Why are so Many Economists so Opposed to Methodology?" *Journal of Economic Methodology*. 1, pp. 105–133.

Leightner, J. E. 2003. "Utility versus Self-sacrificing Love." *Christian Scholar's Review*. 32, pp. 317–328.

Lewis, P. A. 2003. "Recent Developments in Economic Methodology: The Rhetorical and Ontological Turns." *Foundations of Science*. 8, pp. 51–68.

Lunn, J., and R. Klay. 1994. "The Neoclassical Economic Model in a Postmodern World." *Christian Scholar's Review*. 24, pp. 143–163.

Machlup, F. 1955. "The Problem of Verification in Economics." *Southern Economic Journal*. 22, pp. 1–21.

_____**.** 1978. "What is Meant by Methodology: A Selective Survey of the Literature." In *Methodology of Economics and Other Social Sciences*. New York: Academic Press.

Mankiw, N. G. 2001. *Principles of Economics*. 2nd edition. Fort Worth, TX: Harcourt.

Marshall, A. 1920. *Principles of Economics: An Introductory Volume*. 8th edition. New York: Macmillan.

McCloskey, D. N. 1985. *The Rhetoric of Economics*. Madison, WI: University of Wisconsin Press.

_____**.** 1994. *Knowledge and Persuasion in Economics*. Cambridge: University of Cambridge Press.

McKee, A. F. 1987. *Economics and the Christian Mind: Elements of a Christian Approach to the Economy and Economic Science*. New York: Vantage Press.

Middelmann, U. 1987. "A Response to Stephen Mott." *Transformation*. 4, pp. 36–40.

Mills, J. 2002. *A Critical History of Economics*. New York: Palgrave Macmillan.

Mirowski, P. 1989. *More Heat Than Light: Economics as Social Physics, Physics as Nature's Economics*. Cambridge: Cambridge University Press.

Mott, S. C. 1987. "The Contribution of the Bible to Economic Thought." *Transformation*. 4, pp. 25–33.

_____**.** 1989. "How Should Christian Economists Use the Bible? A Study in Hermeneutics." *ACE Bulletin*. 13 (Spring), pp. 7–19.

Pierard, R. V. 1989. "No Economic System Flows Directly from Scripture." In *Biblical Principles and Economics: The Foundations*, edited by R. C. Chewning. Colorado Springs: Navpress.

Popper, K. R. 1980. *The Logic of Scientific Discovery*. London: Routledge.

Quine, W. V. 1974. "On Popper's Negative Methodology." In *The Philosophy of Karl Popper*, edited by P. A. Schilpp. La Salle, IL: Open Court.

Rabin, M. 1998. "Psychology and Economics." *Journal of Economic Literature*. 36, pp. 11–46.

Redman, D. A. 1991. *Economics and the Philosophy of Science*. Cambridge: Cambridge University Press.

Reijnders, J., ed. 1997. *Economics and Evolution*.

Cheltenham, UK: Edward Elgar.
Ross, A., ed. 1996. *Science Wars*. Durham: Duke University Press.
Roth, A. E. 1988. "Laboratory Experimentation in Economics: A Methodological Overview." *The Economic Journal*. 98, pp. 974–1031.
Schabus, M. 1986. "An Assessment of the Scientific Standing of Economics." *Proceedings of the Philosophy of Science Association*. 1, pp. 298–306.
Schuster, J. A. 1990. "The Scientific Revolution." In *Companion to the History of Modern Science*, edited by R. Olby, G. Cantor, J. Christie, and M. Hodge. London: Routledge.
Screpanti, E., and S. Zamagni. 1993. *An Outline of the History of Economic Thought*. Oxford: Clarendon Press.
Smith, V. L. 1989. "Theory, Experiment and Economics." *Journal of Economic Perspectives*. 3, pp. 151–169.
_____. 1994. "Economics in the Laboratory." *Journal of Economic Perspectives*. 8, pp. 113–131.
Solo, R. 1991. *The Philosophy of Science, and Economics*. Armonk, NY: Sharpe.
Sugden, R. 1991. "Rational Choice: A Survey of Contributions from Economics and Philosophy." *The Economic Journal*. 101, pp. 751–785.
Thaler, R. H. 1991. *The Winner's Curse: Paradoxes and Anomalies of Economic Life*. New York: Free Press.
Tiemstra, J. P. 1993. "Christianity and Economics: A Review of the Recent Literature." *Christian Scholar's Review*. 22, pp. 227–247.
_____, W. F. Graham, G. N. Monsma, Jr., C. J. Sinke, and A. Storkey. 1990. *Reforming Economics: Calvinist Studies on Methods and Institutions*. New York: Edwin Mellon Press.
Twitchell, J. B. 1999. *Lead Us into Temptation: The Triumph of American Materialism*. New York: Columbia University.
Von Mises, L. 1962. *The Ultimate Foundation of Economic Science: An Essay on Method*. Princeton, NJ: Van Nostrand.
Webb, B. G. 1994. "Whose Theology? Which Economics?" *ACE Bulletin*. 23, pp. 45–62.
Wolterstorff, N. 1987. "The Bible and Economics: The Hermeneutical Issues." *Transformation*. 4, pp. 12–24.
Wuthnow, R., ed. 1995. *Rethinking Materialism: Perspectives on the Spiritual Dimension of Economic Behavior*. Grand Rapids, MI: Eerdmans.
Zey, M. 1998. *Rational Choice Theory and Organizational Theory: A Critique*. London: Sage. ■