

Reflections on the Three Controversies in Economic Methodology by Virtue of the Philosophy of Science

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The philosophical foundation of the mainstream neoclassical economics is empirical philosophy. The controversies of economic methodology over inductive and deductive methods, over verificationistic and falsificationistic approaches, and over positive and normative analyses in the evolution of economics are associated with those in the philosophy of science. The evolution of philosophy of science suggests that the above—mentioned pairs of economic methodologies should be appropriately combined when used in economics. It is not sensible to overemphasize either one inside each pair of economic methodologies.

Keywords: philosophy of science, economic methodology, induction, deduction, verification, falsification, positive analysis, normative analysis

Introduction

In the history of economic thought, there has been three major methodological controversies. They are controversies over induction and deduction, over verificationistic and falsificationistic approaches, and over positive and normative analyses. In order for the discipline of economics to be more useful to solution of real problems, it is really meaningful to review the three controversies through the lens of philosophy of science.

Controversy Over Induction and Deduction

The evolution of the philosophy of science indicates that the inductive and deductive methods are a pair of scientific methods and both have their own strengths and weaknesses. Therefore, they should be used together in scientific research.

On the first point, the notion of science by classical inductivists goes as follows: science comes from observation, scientific theories are based on observational statements and observation itself must be objective; induction is a method for scientific theorizing; the progress of theories of science is a knowledge-accumulating process. The classical inductivists hold that empirical facts are true and the inductive method is reasonable. Therefore, scientific knowledge, which is based on empirical observation and acquired by induction, will not be erroneous and the evolution of science is an accumulative process of true knowledge.

For decades, induction was believed to be an appropriate method for science. It was David Hume who first challenged its legitimacy for scientific exploration and pointed out the problem of induction. The doubt David Hume cast on the legitimacy of induction pointed out the limitations of induction as a scientific method, which

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justified an attempt to testify the legitimacy of induction in scientific investigation but the justificatory attempt ended up with failure.

Contemporary inductivists have made clear distinctions between context of discovery and context of justification. They hold that there is no logic law governing the context of scientific discovery and that scientific theories are not derived from induction on the basis of observed facts but are invented for the sake of explaining them. This belief has negated the role of induction as a scientific method in scientific discovery. However, the role of the inductive method in scientific research should not be denied or underestimated.

Moreover, the notion of science by traditional deductivists holds that science is a collection of true propositions. Therefore, science is made up of absolutely correct and exact knowledge. Traditional deductivists believe that science bases itself on axioms, which are intuitionistic and self evident; axioms provide the premise of scientific propositions. With this premise, scientific theories can be derived through deduction. However, there exist other problems in the deductivistic notion of science. For example, the negation of the fifth axiom of Euclidean geometry (i.e. the axiom of two parallel lines) resulted in new axioms, which helped in creating non-Euclidean geometry.

In spite of its limitations, it is not right to deny the roles played by the deductive method in scientific discovery. The main roles of deduction go as follows: deduction plays a significant role in justifying theories, i.e., it can not only evaluate theories before they are testified by practice but also render them more logical and rigorous; deduction is very important in explaining facts or predicting the future, i.e. it can infer factual propositions from theoretical ones, thus explaining known facts or predicting facts yet to be known; deduction is also of great importance in discovering difficult questions, i.e., it is of great value to apply deductive reasoning to bringing forward difficult questions.

Furthermore, induction and deduction are closely interrelated. In other terms, induction won't do without the deductive method. This is because: induction is not blindfold, i.e. induction is guided by theories or axioms, which necessitates the utilization of the deductive method; confirming and improving the reliability of conclusions derived from induction requires the continuous use of conclusions to analyze the subject matter, which needs the application of deduction. In the meantime, deduction won't be appropriate without the inductive method, which is mainly because the prerequisites of deduction come from induction.

The controversy over logic abstraction and historical description came forth in the history of economics, which was centered on that over induction and deduction in the philosophy of science. The controversy justified the point of view of the philosophy of science that induction and deduction should be combined in a balanced and coordinated way.

Adam Smith made use of both abstract deduction and historical induction in economic enquiry, exemplified in his masterpiece *An Inquiry into the Nature and Causes of the Wealth of Nations*. David Ricardo abandoned the method of historical description and insisted only on the method of abstract deduction, which J. A. Schumpeter, in his book *A History of Economic Analysis*, called "Ricardian vice". John Stuart Mill, in fact, inherited the methodology of Adam Smith, though he believed that the inductive method would fail in social sciences and deduction was the only appropriate method.

List and Roscher, as representatives of the old historical school of economics, criticized heavily the economic methodology of Smith, Ricardo and Mill, and thought that the abstract deductive model of orthodox economic methodology was no more than a mechanical imitation of the methodology of natural sciences, which was not suitable for social sciences. Social sciences were supposed to make use of the methodology of historicism.

However, the old historical school of economists didn't agree in handling the relationship of theoretical deduction and historical induction.

Some radical economists thought that historical induction was the only effective economic method and claimed to give up the method of theoretical deduction. Some moderate economists argued that the two kinds of methods complemented each other. In 1883, Menger attacked the economic methodology of the historical school from the stance of building abstract deductive model, which triggered the first well-known controversy over economic methodology between Menger and Schmoller.

Schmoller was one of the main representatives of the new German historical school. The economic theories and policies which he stuck to were mostly in agreement with those of the old historical school. Although he paid much attention to the inductive method in the economic science, he thought that both induction and deduction were necessary methods in economic enquiry and it was not appropriate to overstate either of them while neglecting the other.

The controversy between Menger and Schmoller over economic methodology had greatly affected later-on economists and made them realize that induction and deduction were not exclusive to each other; therefore, it is not reasonable to overemphasize either one of them while ignoring the other. Many economists after Menger and Schmoller, such as Marshall and Keynes, tried to combine and harmonize the two methods.

Marshall believed that theoretical deduction was a very important method for economic enquiry. However, the abstract deduction proposed by classical economists, represented by David Ricardo, didn't take social changes into account, which became the main deficiency thereof. The way to overcome this deficiency is to combine theoretical abstraction and historical analysis, and induction and deduction. In his well-known book *Principles of Economics* Marshall followed the lead of Adam Smith's methodology and combined the two kinds of methods. Marshall argued that induction and deduction were two indispensable methods in the economic science; they were closely correlated and inseparable; deduction was based on induction and induction contained deduction.

In *The Scope and Method of Political Economy* published in 1890, John Neville Keynes ended, in an all-round manner, the first economic methodology controversy. He concluded that it was no doubt that deduction played an important role in economics but the part played by induction should not be neglected; the two methods are compatible. Though the premise of deduction and the testing of its conclusions must resort to observation and induction, which make the reliable foundation of all natural sciences, the solution of complex economic problems must make use of both (empirical) induction and deduction. Using only one of them would render scientific discoveries much biased.

From the end of the 19th century till the first twenty years of the 20th century, institutional economics rose dramatically and prevailed subsequently. Institutional economists are, methodologically, extreme inductivists. However, in the 1930s, institutional economics declined. Lionel Robbins's economic methodology replaced that of institutional economics. In his writing *An Essay on the Nature and Significance of Economic Science* in 1932, Robbins proposed to restore the tradition of logic deduction. After the publication of Robbins's essay on economic methodology, especially after the Second World War, there arose a new trend of falsificationism and behaviorism in orthodox economic methodology, which produced far-reaching influence to most economists. Despite that, some economist of the modern Austrian School, still stick to logic deduction, which means that the controversy over induction and deduction in the circle of economics lingers on, till the present day and most ideas are tautology of the past views and don't go beyond what John Neville Keynes dealt with.

Controversy Over Verification and Falsification

According to the philosophy of science, verification and falsification, as another pair of scientific methods, have their own merits and limitations. Therefore, they should be used together in scientific research.

The philosophy of science went through a process from logical positivism to falsificationism, which showed that conclusions testified by verification and falsification, emphasized by logical positivism and falsificationism respectively, are impossible to be final and complete. This is so for the following reasons.

First of all, induction, as the basis of verification, is not always reliable. It is believed that the contemporary inductive method can only verify a theory to some extent; it can't completely verify the theory. This kind of verification, in a sense, is actually weak verification. Popper believed that verification based on induction is logically wrong. The traditional view holds that theory p is true if it infers conclusion q while conclusion q can be tested and proved true by observation and experiment. The logic form is $(p \rightarrow q) \wedge q \rightarrow p$.

However, this reasoning is not logically effective. Meanwhile, even if conclusion q is justified by lots of facts, theory p still cannot be verified. In other words, verification is not final and complete. On the contrary, the following logic is effective: $(p \rightarrow q) \wedge \neg q \rightarrow \neg p$, which is the Popperian mode of reasoning by means of falsification. In other words, theory p can be falsified by proving conclusion q false by a great number of facts.

Moreover, falsification is complex. At the beginning of 20th century, Pierre Duhem pointed out conclusion q was derived from a group of premises and they were made up of theory p and its prerequisites. Therefore, conclusion q is derived not only from theory p , which has already been tested, but also from its prerequisites, e.g. background knowledge. Lakatos argued that a theory needed a protective belt which was composed of auxiliary assumptions. Accordingly, the logic reasoning of falsification mentioned above is $[(p \wedge s) \rightarrow q] \wedge \neg q \rightarrow (\neg p \vee \neg s)$. In other terms, when conclusion q is falsified by lots of facts, theory p probably will not be falsified, i.e. theory p won't be necessarily false because it may be premises falsified, i.e., the premise may be false.

Pierre Duhem further explained that there would be more complex cases. He believed that several hypotheses would be involved in order to draw conclusion q . In this case, if the premises are correct, a false conclusion q can only prove those hypotheses to be false. As to which hypothesis is wrong, further examinations are needed.

With the appearance of abnormal facts which won't go well along with known theories, scientists won't abandon them in haste but protect them from refutation by adjusting specific hypotheses and making appropriate modifications, within the original framework, to enable theories to account for new facts, thus rendering theories more perfect.

On all account, verification and falsification are complex in nature, and neither is definitive and complete. Therefore, their limitations must be taken into consideration while using their legitimacy. In other words, when a certain theory is verified or falsified, it doesn't mean that the process of verification has ended finally; verification should be utilized in a comprehensive way. Logical positivism emphasizes verification over falsification while falsificationism falsification over verification, neither of which is right.

As a matter of fact, the historicist philosophy of science justified that the integration of verification and falsification. Thomas Kuhn and Paul Feyerabend argued for relativism, disaffirmed verification and falsification but failed in the end. Kuhn noticed that there existed a phenomenon called paradigm in the history of science. He divided science, according to whether a paradigm has changed or not, into two stages: conventional and revolutionary. At the conventional stage, scientists do scientific research within a certain paradigm, which denies

the Popperian thought of falsification. During this period, scientists believe firmly in the paradigm; it is of no great significance to prove whether facts are consistent with established theories. The concept of conventional science is different from that of positivism. At the revolutionary stage, the competition between various paradigms can't be decided by experiments. There are no higher criteria in choosing a specific paradigm than the collective agreement of a group, which is exactly the same in political revolution. It can be seen that Thomas Kuhn went in the direction of relativism and he disaffirmed both verification and falsification.

However, the historical evolution of science makes it clear that the empirical content of scientific hypotheses or theories is meaningless without empirical verification or falsification and that it is very hard for people to accept and believe these scientific hypotheses or theories.

Later on, Thomas Kuhn listed five characteristics of "good" scientific theories: exactness, consistency, universality, simplicity and validity in 1979, which meant that he went back to the track of verification and falsification. Paul Feyerabend brought forward the concept of theoretical immensurability in historical studies of science and thought that verification and falsification had a lot of limitations. He was even against methods, and argued that there was no fundamental difference between science, superstition, magic and astrology. Paul Feyerabend's point of view is obviously wrong.

Imre Lakatos put forward the methodology of scientific research program attempting to harmonize verification and falsification. Though his methodology was deeply rooted in Popper's falsificationism but he actually developed it. Lakatos suggests a distinction between "progressive" and "regressive" research programs. In essence, a research program is regressive if it is creatively and adaptively growing in response to new information and progressive if it leads to unknown and new facts. He thought that new facts need empirical verification instead of Popper's falsification. Therefore, it is "verification" that keeps a research program progressive.

Laudan, for the sake of ruling out or shying away from the debate over verification and falsification, argued that the legitimacy and progressiveness of theories had little to do with their verification and falsification and the process of problem-solving had nothing to do with the trueness or falsity of theories. In his problem-solving model, however, a solved problem is actually a combination of the statements drawn from theoretical inference and from experiments, the essence of which is, by nature, verification while an unconventional problem is an empirical one which remains unsolved by a certain theory but will be solved by one or many competing theories, the practice of which is exactly falsification. In other terms, Laudan bridged verification and falsification and synthesized them.

In conclusion, though verificationism and falsificationism have their own weaknesses, it is not right to give up the effort to seek the empirical basis of science theories or hypotheses.

In the history of economics, there arose a similar controversy over verification and falsification, which was closely related to the one in the philosophy of science. The controversy proves that it is reasonable to combine verification and falsification in research, which is supported by the evolution of philosophy of science.

John Stuart Mill put forward the law of tendency when dealing with how to test economic theories. The law of tendency is interpreted as follows: owing to the interference of disturbing factors, judgments and predictions made by economic theories cannot achieve the expected exactness; they only point out a tendency towards the direction of judgments and predictions. Therefore, theories can be tested only when the 'ceteris paribus' clause has been satisfied. In other words, only when the disturbing factors have been excluded can theories attain their exactness, which is obviously an application of Mill's thought of positivism in economics. On the contrary, if

predictions made by a particular economic theory are wrong, it can't be concluded that the theory is definitely wrong, which is because of the possible presence of disturbing factors. As a consequence, John Stuart Mill believed that verification couldn't prove economic theories true or false; only after the presence of disturbing factors are confirmed can economic theories be tested. If there do exist disturbing factors, it can be concluded that it is a wrong application and there is nothing wrong with the theory itself.

In *An Essay on the Nature and Significance of Economic Science*, Lionel Robbins argued that the fundamental problem of orthodox economic methodology was that of testing the exactness of theories. He distinguished the exactness and practicability of theories and claimed that the exactness of a particular theory is a problem of logic inference from a certain premise; the practicability of it in a context depends on the extent to which the theory responds to the various factors which play a role in the context. The criteria to accept or reject a theory rely on whether or not the theory can be tested by observation or introspection, i.e., whether or not it can be verified by the latter. Lionel Robbins's idea indicates that the methodology of a priori prevailed in economics during the period of 1930s because this kind of methodology argues that economic theories are derived completely from introspection and won't be tested by the outside world.

After the publication of Lionel Robbins's essay, there arose a new trend of economic methodology called falsificationism and behaviorism which objects to verification. Terence Hutchison, in his famous 1938 essay, *The Significance and Basic Postulates of Economic Theory*, proposed to introduce Popperian falsificationism into economics and claimed that economics must go through empirical tests to be accepted as a qualified scientific discipline. In general, it was assumptions (not predictions) of economic theories that should be testable; all assumptions should be tested by empirical evidence acquired through observation. Therefore, Hutchison attached great importance to verification, the result of which is that his thought was criticized by apriorists.

Percy Williams Bridgman became known for "operational" philosophy of scientific methodology, according to which science should restrict itself to concepts definable by specific physical operations after his work *The Nature of Physical Theory* was published in 1936.

In his well-known book, *Foundations of Economic Analysis* (1948), Samuelson contended that the basic aim of economics was to derive practical and operational economic theories, which are actually hypotheses about empirical material. These hypotheses can only be negated in thinking under ideal conditions. It can be seen that Samuelson's methodology of operationalism has something in common with Popperian falsificationism. It is no wonder that Samuelson was believed to be a falsificationist. The central message of the behaviorist methodology lies in the belief that theories should be associated with reality and with observed facts and that theories are valid if they can stand frequent testing of factual evidence. The so-called behaviorist theory is, in fact, a variation of empiricism.

Gordon H. Clark defined the theorem of behaviorism as a finished behavior, the result of which is a test towards theories. Some economists think that there are few differences between Gordon's behaviorism and Popperian falsificationism.

In *Essays in Positive Economics*, Milton Friedman expounded the methodology of positive economics, which actually applied Popperian falsificationism into economics. He argued that theories, as a system of positive hypothesis, should be tested by their capability of prediction. He firmly believed that only empirical evidence can prove theories true or false. To put more accurately, the only appropriate test on hypotheses is to compare their prediction with empirical evidence; if predictions are not in accordance with empirical facts, hypotheses

should be abandoned and otherwise they should be accepted. Theories which survive many tests are gain great credibility.

Friedman also contends that empirical evidence can never verify the exactness of a theory; the exactness thereof can only be revealed by its falsifiability, which means the same when theories are said to have been confirmed in practice.

Although in the late 1950s there was a trend in orthodox economics of transcending falsificationism, a lot of economists, such as Joan Robinson, Richard Lipsey, Bruce J. Caldwell and institutional economists, were still influenced by it. In 1962, Joan Robinson published her famous work *Economic Philosophy* and held that Popperian falsificationism is the dividing line between metaphysical and scientific propositions.

In the first edition of his book *An Introduction to Positive Economics* published in 1963, Richard Lipsey assured that what he believed is Popper's "simple falsificationism". In the second edition, however, he converted his belief to Lakatos's sophisticated falsificationism. He argued that neither verifying nor falsifying a theory is the final test upon theories. Later economic methodologists are still affected by Popperian falsificationism, though they tried to transcend or replace it. Just as Mark Blaug held, modern economics is branded with falsificationism; falsificationism has won the battle of economic methodology in modern economics. He believed that the essence of falsificationism lies in its tenacious and distinct predictions, in its efforts to refute predictions and in its rigorous refutation according to the possible reasons to give up hypotheses.

In conclusion, the controversy over verification and falsification in orthodox economics has been in existence for long and it will still linger. The debate makes it clear that both verification and falsification are important and necessary in economic enquiry; any attempt to emphasize one over the other is definitely wrong. Just as Mark Blaug pointed out, the current task is to persuade economists to utilize falsificationism in a serious and proper way. That is to say, verification and falsification should be integrated in order to use them properly in economics.

Controversy Between Positive and Normative Analyses

Positive and normative analyses have their own merits and limitations and should be used together in scientific research, which is proved true by the progress of the philosophy of science, especially by the methodological shift from Auguste Comte's positivism to Thomas Kuhn's paradigm theory.

Comte, founder of the positivist philosophy, argued that the word "positivist" means real, practical, exact and certain, and philosophy should be based on empirical natural science and should take observable and empirical facts as its content. Therefore, Comte was against theology and metaphysics which, in his terms, were hypocritical, useless and inexact. Comte also contended that all scientific knowledge ought to be based on empirical facts acquired through observation and experiments and empirical facts were the only source of knowledge. In this way, scientific knowledge is limited to and can't go beyond positivism. Otherwise, knowledge will lose its foundation and become impossible. He also believed that what is behind empirical facts goes beyond the content of positivist knowledge. Accordingly, Comte thought that positivist philosophy or knowledge ought to include the following items: unchangeable natural laws, which are aimed, based on empirical facts, at exploring causal links of matters; description of empirical facts, which is aimed at depicting the world. For example, Comte admitted that the Newtonian law of gravity is a natural law, which implies that there exists gravity in nature and it is governed by the law of gravity. The problem of what gravity is goes beyond the scope of positivist knowledge

and remains unresolved. People will go deep into an awkward situation of theology and metaphysics if they get to the bottom of gravity.

Comte's positivist philosophy was the first attempt to define philosophy of science. Philosophy of science, starting with his definition, took root and went through several stages from logical positivism to historicism with Popper's falsificationism as watershed. A noticeable difference in the philosophy of science before and after Popper was that logical positivism excluded metaphysics while historicism, with various degrees, included metaphysics. The neo-realism, which appeared after the historicist philosophy of science, mainly explored metaphysical issues like ontology, epistemology and the notion of science. It was obvious that metaphysics contained value judgments, which is exemplified by Kuhn's theory of paradigms.

Although Thomas Kuhn never gave clear, exact and definitive explanations towards the concept of "paradigm", "paradigm" itself is closely related to another concept called scientific community, which consists of the total body of scientists, its relationships and interactions. "Paradigm" is something shared by the scientific community. In his book *The Structure of Scientific Revolutions*, he mentioned the word "paradigm", which, both in practice and in logic, is close to the concept of scientific community; he argued that a paradigm is something and the only thing shared by the scientific community. Thomas Kuhn refers a paradigm to a system of traditions, models or theoretical and methodological beliefs, which are shared by the scientific community.

In general, a paradigm can be seen as the common beliefs held by the scientific community of a field or discipline. These beliefs prescribe the basic theories, views and methods of the community and provide it with applicable theoretic models and problem-solving frameworks, which form a common tradition of a subject and orient it towards a common direction. It is evident that a paradigm is a belief, which contains values exactly like religious beliefs. Thanks to the common values, the scientific community can exist; a paradigm, by all means, contains other subjective factors.

In all, the evolution of the philosophy of science from positivism to the paradigm theory shows that Comte's positivism sees science as completely empirical and having nothing to do with values; Kuhn's paradigm theory, however, denied that point of view and stressed that science and its progress have much to do with values, which play an important role in scientific exploration. In short, positive and normative analyses should be utilized holistically; normative analysis should be given enough attention.

A similar controversy over positive and normative analyses emerged in economic methodology. Likewise, the controversy was predicated on the one in the philosophy of science and it proves that it is reasonable to combine positive and normative analysis in research.

In economics, it is argued that positive analysis consists of objective and empirically verifiable statements. It deals with "what is", not with "what ought to be" and takes no particular ethical position and makes no value judgments. Normative analysis is supposed to be composed of subjective and unsubstantiated statements that lack positive knowledge or proof. It deals with "what ought to be", not with "what is", and makes value judgments that reflects particular ethical views. Positive analysis alleges to eradicate value judgments and belongs to positive economics while normative analysis insists on them and belongs to normative economics.

In economic discussions, the controversy about positive and normative can be dated back as early as to Nassau Senior and John Stuart Mill. They preferred positive economics to normative economics. They contended that the positive-normative distinction should correspond to the distinction between the science and the art of political economy. The science here refers to positive economics while the art normative economics, which

influences substantially economic policies. Senior and Mill contend that economists shouldn't give policy proposals while taking the stance of economists, which implies that economics is not supposed to consist of value judgments and they are only in support of positive economics and exclude normative economics.

David Hume made a strict distinction between positive and normative statements. He brought forward a famous philosophical question which goes like this: 'what ought to be' can never be inferred from 'what is', a principle which is called Hume's Razor implying that positive statements can never be extrapolated from normative statements.

Different from Senior and Mill's distinction of the positive science and the normative art, John Neville Keynes put forward the trichotomy of science and distinguishes economics among "a positive science ... a body of systemized knowledge concerning what is; a normative or regulative science ... a body of systematized knowledge discussing criteria of what ought to be; an art (of political economy) ... a system of rules for the attainment of a given end".

However, J.N Keynes's trichotomy doesn't gain any approval and acceptance of other economists. Vilfredo Pareto distinguishes pure economics from applied economics. He argues that pure economics only includes a positive economics but not what John Neville Keynes calls a normative economics and an art (of political economy); Pareto optimality is a pure economic proposition, independent of judgments of economic ethics and consequently, normative economics.

Later economists, such as Ernest Nagel, Gunnar Myrdal, Joan Robinson and Paul Samuelson, Robert L. Heilbroner etc., had been dubious towards the dichotomy of economic methodology. Nagel claimed to make distinctions between "characterising" value judgements, where the judgement "expresses an estimate of the degree to which some commonly recognised (and more or less clearly defined) type of action, object or institution is embodied in a given instance", and "appraising" value judgements, which express "approval or disapproval either of some moral or (social) ideal, or of some action (or institution) because of a commitment to an ideal". Nagel believed that "characterising" value judgements are inevitable in social sciences, which should not, in principle at least, be bothered by "appraising" value judgements. The implied meaning is that there still exists a positive economics which remains untouched by normative analysis, although Nagel acknowledges the dichotomy of positive and normative.

Gunnar Myrdal, representative of neo-institutionalism, think that positive and normative economics, just like means and end, are commensurable, there being no insurmountable gap between them.; value judgments are omnipresent and indispensable; with no purpose or value, there will be no economic hypothesis and the testing thereof. Therefore, Myrdal contends to take value judgments as a starting point of economic analysis, which helps to enhance the objectivity of economic inquiry. In other terms, normative analysis is the premise of positive analysis and makes positive analysis better. Joan Robinson, economist of the British Cambridge School, attaches great importance to the combination of positive and normative. She argues that it is impossible for economics to be a pure science without value judgments; the moral and political viewpoints, with which economic issues are observed, are invariably entangled with economic problems raised and the methods thereof.

Paul Samuelson, representative of the Neoclassical Synthesis, believes that subjective factors like value judgments are inevitable to penetrate economic inquiry because what economics studies are socio-economic relationships and the laws behind them, which, unlike physics and chemistry, can't conduct controlled experiment, thus resorting to epistemic methods, such as logic reasoning and statistical induction.

Robert Heilbroner, in 1973, heavily criticized the claim that economics should get rid of value judgments. He argues that natural sciences and social sciences have great differences, which lie in the fact that human behaviors are governed by motives and intentions. No conclusions can be drawn without given assumptions. That is, there would be no positive analysis without normative analysis. He adds that economist like other researchers, (un)consciously, carry out tasks with a desire while taking no account the harm thereof; it is impossible for economists to eradicate value judgments and their research is sure to be filled with normative analysis.

In brief, the relationship between positive and normative analyses should be:

On the first point, normative analysis should be based on positive analysis. This is so because the deductive prerequisite, which is necessary for normative analysis, and the result acquired from normative analysis should be tested by empirical facts. Furthermore, positive analysis should be conducted on the premise of normative analysis. This is so because the aim of economics lies not only in obtaining the assumption tested by empirical facts, thus establishing normative economics, but also in guiding economic practice by applying the normative research finding, including economic policy implications. It has been shown that there is positive analysis in normative analysis because the conclusions of normative analysis need to be interpreted through positive analysis; profound and meaningful normative analysis needs to resort to positive analysis. In addition, there is normative analysis in positive analysis.

Conclusion

The controversies over inductive and deductive methods, over verificationistic and the falsificationistic approaches, over positive and normative analysis, give rise to the following conclusions: the philosophical foundation of orthodox economics is empirical philosophy; it is sensible to understand economics from the perspective of the philosophy of science; economics is becoming a science though it is not a science in a strict sense; induction and deduction, verification and falsification and positive analysis and normative analysis should be appropriately combined when used in economics. It is not reasonable to overemphasize either one inside each pair of the economic methodologies.

Acknowledgements

This paper is supported by the Research Project titled “The Role of the Global Development Initiative in Promoting Balanced, Coordinated and Inclusive Global Development” (ID: 3162022ZYE03) and funded by the Basic Research Funds for Centrally Administered Institutions of Tertiary Education.

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