Assessing the Possibility of Endogenous Revolution of Social Science

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***Abstract*—In the situation that various social problems remain unsolved, many citizens, natural scientists and technologists are dissatisfied with the performance of social science. Based on the progresses of natural science and technology, natural scientists and technologists propose the methodological change or revolution of social science and demand social science to import natural science and technology methods. This paper identifies the dissatisfactions of natural scientists and technologists with the *status quo* of social science. Then this paper places their dissatisfactions in the stream of the 20-th century's history of natural and social science and humanities. Reflecting the history, this paper advises social science to collaborate with natural science and technology and advises natural scientists and technologists to respect the ethos of social science behind the social science methods for the endogenous revolution of social science.**

***Index Terms*—Endogenous revolution, import of method, collaboration of natural and social sciences, social science revolution.**

I. Introduction

A. Problem Statement

Many citizens require the radical advance of social science to manage the problems of sustainable development in harmony with environment, resources, economic inequity, and others [1] possibly with the reorientation, the breakthroughs, the paradigm shift, or the revolution of social science [2], [3], although some of the criticisms by natural scientists and technologists against social science may be pointless [4] because of their limited knowledge about social science.

Social science is advancing but not enough to solve the problems. As histories show that natural science has solved the problems by the science revolutions [5], the social science revolution may be expected to be useful in solving the social problems. There may be a need to explore its possibility.

Many works have appeared about the history and the philosophy (the view of the nature, the scientific validation criteria, *etc*.) of natural science and technology. Those will be denoted by metatheory hereafter. But few works are widely known about the matatheory of social science (the general theory of society as a whole, the comprehensive history and the ethos of the entire areas of social science, *etc*.). Exceptionally, Marxian social science has the own metatheory (the dialectical materialism view of the nature and society) and early sociologists developed the metatheory for pre-branched social science as empirical social philosophies (Comte, Durkheim, Simmel, *etc.*) based on the positivism philosophy against the Hegel's speculative one. Meanwhile, the metatheory of each area (*e.g*., the definition of the area) in social science usually appears only in the first few pages of disciplinary textbooks.

Hereafter, "methodology" and "method" denote the synthetic view (paradigm) and the analysis technique, respectively, although often inseparable. Analogously, "idea" and "concept" denotes the general and the operational aspects of thoughts, respectively, although often inseparable.

For the metatheory of natural science and technology, many professional societies publish the peer-reviewed research journals at international levels and many universities offer the lectures titled as philosophy, history or sociology of science. Contrastingly, fewer professional societies, fewer universities and fewer peer-reviewed journals are known for the corresponding themes of non-Marxian social science (modern social science, hereafter).

Excepting a few [6], modern social science ignores the sociology or political science of social science. Contrastingly, many natural scientists and technologists respect the metatheory of natural science and technology by regarding natural science and technology as the product of human activities in society [7]-[9]. Further, many natural scientists and technologists join the discussion about natural science and technology policies for promoting or assessing natural science and technology. Social scientists discuss governmental policies including natural science and technology policies but seldom discuss the governmental policies for social science. This is partly because governmental budgets more decisively affect natural science and technology development than social science development. Moreover, governments ethically or militarily regulate natural science and technology but avoid regulating social science. "Science policy" usually denotes the natural science and technology policy.

In these aspects, ironically, natural scientists and technologists more involve themselves with social or ethical problems than social scientists do. Natural scientists and technologists admit the influences of society or human mind (*e.g.*, the view of nature or life) on natural science and technology. However, many modern social scientists disregard the social constraints on their activities. Denying the Marxian materialism that stresses the social constraints on human activities including social science researches, modern social scientists implicitly hold the idealism philosophy to claim the transcendence of social science above real constraints. This transcendentalism obstructs social science from treating real problems in society and social science revolutions.

With the agreed view about natural science, the comprehensively titled journals of natural science (*Nature* and *Science*) are professionally respected by natural scientists

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and technologists and publish several articles concerning socio-ethical (environment, health, weapons, *etc*.) problems. This makes a contrast of the transcendentalism of social science to the society-involved natural science and technology. Social science is usually believed closer to humanities than natural science is. In the above-stated regards, however, this contrast indicates that social science is more distant from humanities than natural science and technology is. Indeed, this is quantitatively evidenced by some trends of published articles [10] in journal "*Science*", where "humanities" denote philosophy, history, linguistics, classics, psychology and pedagogy.

Hereafter, "revolution" denotes the paradigm shift in accordance with the Kuhn's terminology, meanwhile the technical advance is denoted by "innovation" as in economics. Kuhn himself used the word "scientific revolution", while many others use "science revolution". This paper regards these as synonymous.

B. Idea of Social Science Revolution

The revolution is the central idea in the histories of society, natural science, humanities and arts. Copernicus used the word "revolution" in the title of his astronomical work. Although "revolution" might merely mean "physical rotation" here in his work, his theory is recognized as revolutionary [11, 12]. Kant called his own subjectivism philosophy another Copernican revolution. Today, many philosophers agreed with him. The Neo-Kantian and the logical positivism philosophies provided natural science, mathematical logic, linguistics, psychology, sociology, jurisprudence and others with the metatheory. This led to creating a new field called semiotics as a revolutionary field, which comprehends all areas of humanities including the philosophies of natural, social, mathematical and information sciences.

Many natural science historians use the word "revolution" for Galileo, Lavoisier, *etc*. [13] while some economists say "Keynesian Revolution" [14], [15]. Associated with the quantum revolution in physics, the idea of social science revolution was discussed as social engineering [16]. In discussing the Kuhn's theory of science revolution, few social scientists mention Keynesian Revolution [17], [18]. Many Marxists regard Marx a successor of Smith as Marx himself claimed. Many Marxists regard Leninism, Stalinism and Maoism as the applications of Marxism to the new situations without revolutionary change of Marxism.

Contrastingly, the revolutions in idea are important in humanities like the history of philosophy (Descartes, Kant, *etc*.), linguistics (*e.g*., semiotics under the impacts of the logical positivism, the pragmatism, and the Neo-Kantian epistemology), *etc*. This is perhaps because humanities respect history, where revolutions are central. After Industrial Revolution, many economists replace "revolution" with "innovation".

French, Russian and Chinese Revolutions are associated with ideological paradigm shifts. Likewise, the natural science revolutions are associated with the paradigm shifts to change the metatheory. The possibility of such radical shifts are seldom discussed for social science, possibly excepting the social science movement toward New Socialism. Through science and technology history, ironically, natural scientists and technologists are more interested in social history than social scientists are. Natural scientists and technologists are familiar to social history perhaps because one event (discovery, invention, *etc*.) can change the course of natural science, archaeology, technology and social history, meanwhile this is not seen in economies except for Industrial Revolution triggered by one invention (*e.g*., steam engine).

C. Relevant Publications

The metatheoretic discussions of social science supposedly appear in related journals (Impact of Science on Society; Journal of the History of the Behavioral Science; Philosophy of the Social Science; Science and Public Policy; Science and Society; etc.) and indirectly related journals (American Journal of Science Philosophy; The British Journal for the Philosophy of Science; Critical Thinking across the Disciplines; Inquiry; Journal for General Philosophy of Science; Journal of Technology in Society; Kybernetes; Metascience; Methodology and Science; Science of Science and Management of S&T; Scientometrics; Social Studies of Science, etc.). But almost none discusses social science revolutions except for the proposals of new sciences like cybernetics or systemics [19], [20]. The Kuhn's theory attracted scientific attentions but mainly in the context of philosophy, history and sociology of natural science often by natural scientists themselves. Its implication for social science revolution is ignored. Besides indirectly related books [21], one book directly discusses to reorient economic methods from the mathematical formalism [3].

Humanities were originally to study classics ("bibles"). Succeeding this tradition, historians in academia avoid general discussions (*i.e*., the view of history) and adopt the exegetical or historiographical methods. History is based on evidences and concentrates itself on document analyses. The history departments in academia and the professional societies of history usually ignore the history of natural or social sciences partly because scientists left few documents (*e.g*., experiment notes). Similarly, philosophy in academia tends to engage itself in the exegeses of classics. Some philosophy departments in universities offer the lectures "science philosophy", which excludes social science philosophy except for the lectures by Marxists. Likewise, the professional societies of science philosophy seldom discuss social science. The situation is worse for sociology of science. As compared with philosophy and history of science, the professional society of sociology of science of Japan is much younger and much less active with much less members. Further, the situation is worse for political science, economics, jurisprudence of natural and social sciences. Excepting Marxists and science sociologists, almost nobody says "political science or economics of natural or social science".

D. Research Questions

This paper inquires why and how social science is different from natural science in metatheory; and with what methodology the social scientific revolution can take place.

E. Method

This paper explores the possibility of social science revolution possessing the self- or joint-developed methodology. The revolution of science philosophy is measured in terms of the numbers and the patterns of

citations [22]. Considering the fact that the definition of natural science revolution is controversial [23, 24], however, this paper avoids its verbal definition and explores its characterization. This exploration is future-oriented without given chart or statistical data.

Our method is to generate hypothetical concepts about the future from the past, because hypotheses are often generated by conceptually learning lessons from the relevant areas or the past history. As in the development of forecasting method or futurology, this paper learns lessons from natural and social science histories. In learning lessons, analogy is useful, which is usually prohibited in science but is known powerful to generate radically novel hypotheses. Safety technology has refrained from presenting bold hypotheses (*e.g.*, earthquake prediction), but the public including the Italian court required scientists to change their truth criteria after the earthquakes in Italy (2009) [25]-[27], where scientists were convicted of persisting in their scientific criteria and ignoring the sign of danger, although the retrial reversed the first sentencing. This paper attempts to foresee the future revolution of social science by using the conceptual method of forecasting or foresight.

Among the branches of social sciences, this paper mainly discuses economics, because economy now dominates the entire society and economics is the most successful in shifting from the use of conceptual methods to that of quantitative methods. Psychology is also successful in such shifts, but it may belong to humanities rather than social science.

F. Structure of the Paper

Section II reviews the characteristics of social science innovations endeavored thus far. Section III reviews the past endeavors of natural and social sciences on their boundaries and examines the possibility of social science revolution via their collaboration. Section IV states concluding discussions, remaining problems and future research.

II. Towards the Characterization of Social Science Revolution

A. Science Communities

Natural science communities share the metatheory of natural science. Typically represented by professional journals "*Nature"* and "*Science"*, the agreed matatheory of natural science is accepted by natural scientists. Science education is nearly uniform across countries. Science textbooks describe scientific facts in the order of discoveries (*e.g.*, in the order of Egypt, Archimedes, Newton, and the relativity and quantum theories). These help natural science communities share their metatheory, history and cultural geography. Social scientists also share the natural scientific culture [28] because they receive the same science education at school across countries.

Social science communities, if exist, are in another situation. The agreed concept of social science seems nonexistent. The textbooks of social study or social science are very different between classes, schools or countries. This is not because Marx divided the social science community. It is often said that Marx "invented" *Sozialwissenschaft*, where *Wissenschaft* means science, philosophy or knowledge. But he did not claim that he intended or achieved the social science "revolution", possibly because he avoided this "dangerous" term while exiling to England. Or, in his system of *Sozialwissenschaft*, economics is merely its part, even if economy determines human behaviors and social systems in his materialism view. If economics is merely part of *Sozialwissenschaft*, the revolution of economics is no revolution of the entire system of social science. Earlier, he proposed a new concept of political economics but not as revolutionary against Smith.

B. Classic and Modern Methodologies

In the 1800s, Comte and Simmel conceptually proposed *sociologie* and *Soziologie*, respectively, as the unified concepts of social sciences. Comte more stressed natural science than Simmel, while Simmel more stressed economics than Comte.

As was predicted by the Marxian materialism view of history, economy dominates the entire society today and economics attracts the wide attention. But this situation does not generate the new idea of unified social science as the materialism philosopher anticipated. This is partly because each area is too specialized for the unification and partly because modern economics has innovated the analysis methods against the Marxian synthesis.

Importing the analysis methods from physics, modern economics distinguishes itself from the Marxian. Physics long dominated natural science as a study of substances to which quantitative or mathematical methods are applicable. One of its successful methods was the variation principle that God used the least effort to give the nature the *principia* (Manpertuis' law of the least action). This explained why the earth is a globe as the simplest form, why the light moves straightly (Fermat's principle) as the shortest path, *etc*. Mathematically, the variation principle led to the Hamiltonian, the Lagrangean, *etc*. The Lagrangean provides economics with the mathematical foundation of the marginal value or price: the important concept in economics. The value or price is successfully associated with the cost minimization or the profit maximization by multiplying by -1 when necessary. Anther example is the input/output analysis using the linear algebra. Other examples are differential and integral calculus, differential equations, maximum principle, variation principle, thermodynamic equilibrium, time series analysis, control theory, *etc*.

Using analysis methods imported, modern economics succeeded in exogenous technical innovations without own philosophical foundation. Unlike Marxists, modern economists seldom discuss their philosophical foundation. But this does not mean that it essentially lacks the philosophical foundation. This shall be examined below.

Economics dominates the entire social science, partly because money dominates the entire society as the Marxian materialism philosophy predicted, and partly because money posses the quantitative and calculable property to which mathematics and statistics are applicable. Applying mathematical or statistical methods to political areas, modern economics replaced the socio-political study of election with the voting theory of mathematical economics.

The most successful use of mathematics in economics is

the maximization or the minimization techniques. It is successfully used in the profit maximization or the cost minimization. This is mathematically associated with the variation principle, which is philosophically associated with the view of man as *homo economics* seeking for the cost-minimization corresponding to theology-origin principle of the least (cheapest) action or profit-maximization by multiplying -1.

To philosophically justify the economic maximization (minimization) principle, modern economics expanded its territory to humanities, where the definition of humans has been central since Plato. Modern economics presented the own view of humans: *homo economics* against *homo sapience* (wise or ethical man) to replace the traditional wisdom-based altruism ethics with the autism [29], where the wisdom classically meant ethics.

C. Experimentalism

Aristotelian speculative *physica* was replaced with experimentalism-based physics. Chemistry including pharmacy and some biology including agronomy have basically been empirical despite the authoritative texts by Hippocrates, Shen-nong (China) and others. Departed from speculative philosophy, psychology adopts the experimentalism methodology and develops the own experiment methods including the own statistical tools to analyze experiment outcomes.

Many psychological experiments of economic behavior refute the *homo economics* hypothesis of profit-maximizing or cost-minimizing behavior and evidence the altruism behavior of observed subjects [30]-[33]. Brain- and neuro-sciences support this refutation [34]-[36].

As modern economics models itself on experimentalism-based physics, the experimental refutation of *homo economics* view undermines the methodological foundation of modern economics.

Modern economists may say that the experimental judge by psychologists is not the final one. In many countries, the king or the president has the transcendental power to arbitrarily reverse the law-based judgment by courts. Economy exports jurisdictions the concept and practices of arbitration to upset the judgment based on the legal mind. Classically, the law was regarded as given by god(s) as the natural law was regarded as given by god(s). After the sovereignty shifted from god(s) to the absolute monarchy and then to money, economy holds the sovereignty today.

As market economy is comparatively young, economic disputes are often outside the traditional kingdom of legal system based on divine sovereignty. Newton was motivated by his theological idea, and he believed his Newtonian Law as divinely founded. Still today, the idea of natural laws survives, and laws are morally assumed as based on the traditional ethos. But such legal ideas do not take economic problems into consideration. Therefore, economic disputes are litigated in "economic lawsuits". This is called the arbitration judged by arbitrators, where the trueness criterion is arbitrary. This economic autonomy guarantees economic inviolability. But some policy analysts engaged in technology assessment or environment assessment may deny this inviolability and request economy assessment by publics.

D. Exogenous and Endogenous Developments

Led by cybernetic philosophy, social science imported the control engineering methods [18], [37]. Engineers and sociologists jointly developed the concept "information".

Encouraged at the successful export of the mathematical techniques of classical physics and engineering to social science, some natural scientists attempted to export new methods to social science. When Oil Embargo (1973) caused the catastrophe, chaos, disequilibrium, disturbance, and phase shifts of economy, and required management the cooperative, coherent, or dissipative structures, self-assembly, self-medication, self-organization, or self-renewal functions [38]-[53].

Despite the wide attention of the media, however, these exported methods failed in taking root in social science. This was partly because of the lack of their collaboration with social scientists. Natural scientists found few comrades among social scientists.

According to Lenin, exported revolutions fail. French Revolution, American Revolution for independence and English Industrial Revolution were endogenous and have endured. Unlike the Russian-made revolutions in East Europe, the endogenous revolutions of China, Cuba and Vietnam have endured. Revolutions are assessed as successful if radical changes are realized. But history sees many examples of short-life revolutions in politics, science, music, *etc*.

History shows that endogenous revolutions were successful with some help from outside. Facing with the problems of environment, health care and others, natural scientists wait for the revolution in social science [54] as in life science [55], [56]. But the need alone is not sufficient for the success of revolution. As the needs for efficacious medicine and the reliable calendar by the precise observation of heavenly bodies were satisfied with the experiments and the observation supported by instruments besides modern ideology [57], social science needs instruments for the development. Economics started and developed itself with the economic development, and Marx proposed *Sozialwissenshaft* during the social movements. The ongoing movement by natural scientists and citizens concerning social problems may be appropriate instruments for social scientists to "observe and experiment on" social problems.

III. Natural and Social Sciences Collaborations On the Common Borders

A. Historical Review

History shows that the endogenous revolutions were successful with some solidary helps from outside. Confronted with the problems of environment, health care, and others, natural scientists wait for the revolution in social science and life science as were mentioned above. But the need alone is insufficient for revolutions. Because natural scientific revolutions were achieved by using observational and experimental instruments besides modern ideology or methodology as was mentioned above, social sciences need experimental instruments. Economics grew with Industrial Revolution. Likewise, *Sozialwissenshaft* and social engineering grew with social and quantum-theoretic

revolution movements, respectively. The natural scientists' movement for solving social problems is expected to serve social science as "experimental instruments".

The above discussions indicate that the endogenous revolution of social science may be achieved through the collaboration with natural science.

The collaboration may take various forms. Around WWI, the "renaissance" of unification across disciplines took the form called *Unity of Sciences* or *Unified Science*. Philosophers, physicists, mathematicians (Russell, Mach, Hilbert) *etc*. joined it with formal logic as the universal method. This later raised *Semiotics* for sociology and humanities [58], [59] but not for economics.

Around the 1940s, pragmatic positivists organized *Behavioral Science* encompassing philosophy, psychology, sociology, zoology, *etc*. with the methods of observation, experiment and statistics including the self-developed or endogenous statistical methods like MIDS, SEM, LISREL, Quantification, *etc*. and contributed to *Data Science* [60-62]. But it little attracted economics, which was interested in the monetary side ("economic rationality") rather than the emotion-based behaviors (*e.g*., unorganized "random" behaviors of "irrational" consumers).

The application of *Control Science* to social problems in East Europe and the *Cybernetics* philosophy fostered *Systems Science* with the own general theory using analysis and abstract algebra [63]. Further, systems science adopted the so-called new science methods like the theories of catastrophe, chaos, complexity and others as its tools [46]. Outside East Europe, however, it lacked the connection with real societies.

Cybernetic philosophy, information theory and informatics generated *Informatics* and *Knowledge Science* [64]. These demand new economic models [65], [66].

B. Lessons and Recommendation

The above-reviewed programs are based on the classic idea of science centered about philosophy and mathematical systems. But modern economics is young and its methodological philosophy is based on the idea of *homo economics*, which is incompatible with the *homo-sapience*-based methodologies of the other sciences. Economics uses mathematics but only as tools with no insight into its systemic foundation. This may explain why economics has played a minor role in the above-mentioned collaboration activities based on the classic ideas of philosophy and mathematics. But no collaboration can be successful without economics because economy dominates the entire society today.

Besides these methodology-motivated programs to bridge natural and social sciences, the problem-oriented or mission-conscious collaborations (*e.g*., about environment) are now attempted. As any big social problems of today involve all the areas of social sciences and technology based on natural sciences, such collaborations may attract scientists of many areas.

During WWII, physicists, mathematicians, philosophers, *etc*. started *Operational Research* for military operation's research. Later it fostered *Management Science*, *Research & Development Management*, *Innovation Management*, *Science Policy Analysis*, *Technology and Sustainability Assessment*, and *Policy Science* with the collaboration of natural and social scientists.

Environment Management and *Sustainable Development* concern citizen's behaviors, public ethics, psychology, *etc*. They are often obstructed by the methodological disharmony between natural and social sciences, but this may be solvable. Although economic sectors often decline to control pollutions, the research management for economics may remind economists of the natural scientific origin of economics [67]. As biologists claim, all livings have evolved in nature, the legal idea of natural law is rooted in natural altruism, and the human nature is originally altruistic. History may remind economists that the real production and even the exchange preceded the "invention" of money. The return to natives or the "devolution" of the economic methodology from the autism of *homo economics* to the altruism of *homo sapience* seems scientifically feasible [68]. This devolution helps economics collaborate with *homo-sapience*-based natural science and humanities.

In sum, the collaboration with natural science is expected to revolutionarily revise social science.

IV. Concluding Discussions, Remaining Problems and Future Research

The possibility of the paradigm shift or revolution of social science was assessed. The advances of social science with the paradigm shift from conceptual to quantitative methods were attributed to the import of technical analysis methods from natural science, specifically physical mathematics and statistical physics. The past activities to unify or combine natural and social sciences were reviewed to learn lessons. This review helped identify the usefulness of mathematics, statistics, science philosophy, ethics, and governmental policies for the social science revolution. From these lessons, recommendations were presented for the successful advances in managing social problems. Specifically, the collaboration of natural-social sciences to manage social problems like the environment problem with the aid of the science policy analysis was recommended as promoting the paradigm shift or revolution of social science.

For the purpose to manage social problems that remain unsolved by the present social science, the social science revolution seems needed. Reciprocally, this paper shows that the endeavors to manage social problems help the social science revolution.

This paper refrained from the strong conclusion in the form of "prescription" because the necessary and sufficient condition for the social science revolution was not specified. For presenting stronger recommendations, evidence-based conceptual analyses of the past and on-going activities may be needed to shift the paradigm of social science.

Revolutionary efforts to shift social science paradigm may be conceivable by reorienting the view of humans and society with the aid of experimental brain science. As Copernicus and Kant revolted the viewpoints, social science could "re-view" the society from the experimental results of natural science and "peripheral" corners of society like environment, rural areas, developing countries, welfare, knowledge, or other non-monetary areas. Such "viewpoint revolting" is left for future researches.

This paper focused on economics because economy dominates the entire society today. The other branches of social science will be considered elsewhere.

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