Towards a “philosophy of soil”: A critique of industrial civilization in the history of economic thought of the late 20th century

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Abstract

The aim of this paper is to investigate the issues on ‘economy and ecology’ in the economics of the late 20th century by focusing primarily on the works of Nicholas Georgescu-Roegen, Tamanoi Yoshiro, and Karl Polanyi. Polanyi’s critique of the market society, especially his idea of the fictitious commodities has given the essential point of view the discussions on the theme of ‘economy and ecology’ from the early 20th century to the present. Tamanoi’s *Economy and Ecology* (1978) was its remarkable case in Japan. As the environmental pollution problems such as Minamata disease had become serious through the 1960s, Tamanoi started to investigate thoroughly the problems on ‘economy and ecology’ or ‘economy of the living system’ based on his study on Polanyi’s substantive view of human economy as well as Georgescu-Rogen’s attempt to apply the concept of entropy to economics. Tamanoi also tried to relate physical dimensions to cultural ones and to grasp the human economy as the culturally shaped one within a concrete and local eco-system (i.e. the water-soil matrix). In other words, he clearly associated the entropic theory of living-system with Polanyi’s economic anthropological view. Tamanoi named his own approach ‘regionalism’, and later Ivan Illich who was his close friend characterized it as a ‘philosophy of soil’. Tamanoi, after his retirement of Tokyo University in 1978, taught at Okinawa International University and committed himself to concrete problems of Okinawa. It was his practice of regionalism as well as of his vision of ‘economy and ecology’. By rethinking Tamanoi’s works, we will show a theoretical and practical development of Polanyi’s economic thought in Japan.

1. Introduction

Building on the work of Carl Menger and Max Weber, as well as Aristotle's concept of *Oikonomia*, Karl Polanyi argued that the term 'economy' refers to two aspects. The first is the formal dimension of rational choices on the part of actors, arising from a scarcity of means to achieve an end. The second is the substantive element of actors' interactions with their natural and social environments, because these provide them with the means to satisfy their material needs. Thus, from the latter perspective, 'economy' can be understood as part of their material interdependent relations with, and healthy reproduction of the natural world, which comprises a diversity of living things, plants, soil, and the biogeochemical cycle.

As recent research in the history of science has shown, interest in this biophysical dimension of a human economy, which cannot be reduced to market price mechanisms, is not uncommon. If we examine the evolution of the concept of 'economy', we find it is clearly present in the history of economic thought, and persisted in various forms throughout the Enlightenment and the classical economics of the 18th century. Furthermore, as a law and order of governing wealth, population, resources, and land, economy was also the object of the knowledge of natural science. Paul Christensen argues that pre-classical, Physiocratic, and early 19th-century classical economics, which are closely related to physiology, chemistry, and natural history, focused on the physical side of economic activity, which was missing from mainstream economics after the Marginal Revolution (Christensen 1989, p.18). In addition, Margaret Schabas (2005) also identifies an understanding of economy embedded in the physical order of nature in Swedish naturalist Carl von Linné's 18th-century concept of the 'economy of nature', the work of Quesnay and others (Physiocratic school), the work of Enlightenment thinkers such as Hume and Smith, and 19th-century texts of classical economists such as Malthus and Ricardo.

At the same time, their research shows that interest in the biophysical element of economics clearly decreased from the Marginal Revolution of the mid-19th century onwards. Marginal utility theory, which was developed in parallel by Jevons, Walras, and Menger, eventually stripped wealth of its material quality and substance, and based its approach to economy exclusively on psychological and emotional functions. "Matter no longer constrains or determines [the economic order], as it did for the Physiocrats and the classical economists" (Schabas 2005, p.16). Schabas refers to this transition as the 'denaturalization of the economic order'.

Interestingly, however, thermodynamics, which developed at the same time as the Marginal Revolution, revived the perspective of grasping a human economy in relation to the physical order of nature: that is the tradition of scientific thought called the "Social Energetics". The development of thermodynamics, particularly from the

late 19th century onwards, brought about major reforms in the scientific understanding of nature which was based on Newtonian mechanics. This also proved to be an opportunity to fundamentally revise the epistemological basis of economics during the Marginal Revolution, which had been gaining strength as a mechanical analogue. Economic analyses based on thermodynamics and energetics were conducted by chemists, biologists, and other natural scientists, such as Sergei Podolinsky (1850–1891), Wilhelm Ostwald (1853–1932), Patrick Geddes (1854–1932), and Frederick Soddy (1877–1956). These analyses were extended by social scientists in various ways between the turn of the century and the early 20th century, before being taken up by Alfred Lotka (1880–1949), Otto Neurath (1882–1945), Lewis Mumford (1895–1990), Lancelot Hogben (1895–1975), and Leslie A. White (1900–1975) (Cleaveland 1987; Mirowski 1988; Martinez-Alier 1990).

The research into 'bioeconomics' by Romanian economist Nicholas Georgescu-Roegen (1906–1994) provided an important impetus for the discovery of the intellectual tradition termed "social energetics". In *The Entropy Law and The Economic Process* published in 1971, Georgescu-Roegen examined the significance of entropy law (i.e. the second law of thermodynamics) for the reproduction of the human economy and showed the way in which economic institutions and relations are embedded within the physical world. Throughout the 1970s, Georgescu-Roegen tried to expand the scope of economics to encompass the entire process in which humans as a biological species reproduce life amid the irreversible flow of solar energy. Given the historical context discussed above, his bioeconomics can be placed at the end of the intellectual tradition of social energetists of the mid-19th century onwards.

Also in Japan, against a backdrop of rapidly increasing and severe pollution, as well as resource-related and energy issues during the 1960s and 1970s, the move to radically re-examine the traditional framework of economics from the perspective of the Entropy Law had emerged. Yoshiro Tamanoi (1918–1985) was one of Japan's leading economists who wrestled with the problems on 'economy and ecology'. Interestingly, Tamanoi placed great emphasis on the work of Polanyi, criticizing the "obsolete market mentality" lurking within his contemporary economics, as well as on Georgescu-Roegen's bioeconomic theory. Tamanoi first explicitly addressed the problems of 'economy and ecology' in his 1974 study. The following year, he published a translation of Polanyi's 10 important essays (Polanyi 1975, in Japanese). He subsequently continued to refer to Polanyi's work in his own research on the economics of the living system.

In this paper we investigates the issues on 'economy and ecology' in the economics of the late 20th century by focusing primarily on the works of Georgescu-Roegen and

Tamanoi. In this consideration, we discuss the originality of Tamanoi's economics of the living system and show how this was influenced by Polanyi's ideas.

2. Georgescu-Roegen's bioeconomics and its context

We begin by examining the ideological background of Georgescu-Roegen's bioeconomics, which was one of the major influences on Tamanoi's work. Georgescu-Roegen was a gifted mathematician, and began his academic career in mathematical statistics. However, while studying at Harvard (1934–1936), he met J. A. Schumpeter and the circle of talented economists working with him (Leontief, Lange, Machlup, Morgenstern, Sweezy, and Samuelson, among others), prompting him to move into mathematical economics. Schumpeter was very keen to collaborate with Georgescu-Roegen, who, within a short period, had made a name for himself as a pioneer of mathematical economics. However, in 1936, Georgescu-Roegen decided to return to his native Romania, which was in crisis following the Great Depression, where he remained for the next 12 years, until 1948.

In fact, there was a gap of over 30 years between the papers presented by Georgescu-Roegen as a young mathematical economist and the publication of *The Entropy Law and The Economic Process*, which led to the subsequent full-scale development of his idea of bioeconomics. Thus, let us then consider when, and in relation to which issues his idea of bioeconomics based on thermodynamics took shape. In his final years, Georgescu-Roegen made two references to the route that led him to bioeconomics.[1] The first was encountering the philosophy of science, which rejected mechanics and mechanism, during his time studying in France (1927–1930). At the Sorbonne, he was influenced strongly by the lectures of mathematician Émile Borel on statistical mechanics. The works of Poincaré, Bergson, Whitehead, and others on the philosophy of science guided him to the issues of irreversibility and entropy, which were largely inconsistent with Newtonian mechanics. However, it was not only the philosophy of science and thermodynamics that led to his theory of bioeconomics. As he later recollected: "statistical mechanics being a quite formal and abstract presentation of thermodynamics, I might have remained interested only in the recondite mathematical lucubrations that have later mushroomed in that field, if it had not been for a subsequent experience in Romania" (Georgescu-Roegen 1989, p.161). It was this experience in Romania that "suddenly revealed to me the fundamental role the Entropy Law plays in the economic, actually bioeconomic, process". His final

[1] "I came to realize the indissoluble dependence of the survival of humankind on scarce resources by the combined influence of two sources: Emile Borel's monograph on statistical mechanics (alias thermodynamics), which as a student of statistics I read in the 1920s, and the problems of an overpopulated agrarian economy, of which I became fully aware during my Romanian exile" (Georgescu-Roegen 1992, p.146).

work, *Energy and Economic Myths*, contains the following passage:

> What caused me to look at the economic process from an unorthodox viewpoint is the particular nature of the economy of my native country, Romania, at the time when I returned from my training in the Western schools with a formidable armamentarium of mathematical standard economics. To begin with, I despaired at discovering that that armamentarium could hardly help me penetrate the economic problems of that country. Romania's institutions were not adapted to the Walrasian principle of profit maximization. (Georgescu-Roegen 1976, p.xi.)

> The idea that the economic process is not a mechanical analogue, but an entropic, unidirectional transformation began to turn over in my mind long ago, as I witnessed the oil wells of the Ploesti field of both World Wars' fame becoming dry one by one and as I grew aware of the Romanian peasants' struggle against the deterioration of their farming soil by continuous use and by rains as well. (ibid., p.xiv)

His 12 years in Romania represented a long break in his academic career. However, it was decisive in his move away from mathematical statistics and his subsequent orientation towards the development of bioeconomics. Having returned to Romania from the United States, Georgescu-Roegen was faced with the reality of a poverty-stricken and overpopulated peasant agrarian economy that was far removed from the mathematical world depicted by Walrasian general equilibrium theory. The majority of the Romanian population still pursued an agrarian livelihood, and economic activities mediated by the market and monetary transactions remained vulnerable.

The interests that emerged during his Romanian exile took two distinct shapes during the 1960s: "Economic Theory and Agrarian Economics" (1960) and "The Institutional Aspects of Peasant Communities" (1965). These works discussed the economic system of peasant communities, supported by principles that differed to those of urban cities and civil society in an industrial capitalist society. Interestingly, these works included a fundamental criticism of the doctrine of neoclassical economics, while at the same time setting out a position that supported the historical school and institutional economics.

Georgescu-Roegen emphasized that the biggest factor regulating the characteristics of an economic system was not the technology used, but rather its historical and cultural "institutions". He argued that both the neoclassical school and Marxian

economics were based on the implicit assumption of institutional features inherent to an industrialized and individualistic civil society. "As soon as we realize that for economic theory an economic system is characterized exclusively by institutional traits, it becomes obvious that neither Marxist nor Standard theory is valid as a whole for the analysis of a non-capitalistic economy, i.e. of the economy of a society in which part or all of the capitalistic institutions are absent" (Georgescu-Roegen 1960, pp.361-2). For Georgescu-Roegen, the fatal error on the part of neoclassical economics, in particular, was its misplaced confidence that the theory applied universally to any kind of institutional environment, without being aware of its spatial and temporal limitations. He viewed it as misplaced because it prescribed inappropriate solutions to the economic problems faced by underdeveloped countries, serving only to further exacerbate their economic situation.

> In fact, the greater the industrial development achieved by an underdeveloped nation plagued by a predominant, overpopulated, and disorganized agricultural sector, the stronger the evidence such a nation offers of the fallacy of the industrialization axiom. There the peasantry is still as poverty-stricken as ever—a passive gloomy onlooker at the increasing well-being of the exclusive circle that delights in the Square Dance of Effective Demand, which alone moves faster and faster with each day. (Georgescu-Roegen 1966, p.114)

Thus, Georgescu-Roegen took on the challenge of understanding the internal logic of the historical and institutional environment of the peasant community, which at the time, was in a state of "reality without theory". His main influences in this endeavour were the peasant economy theories of Aleksandr Chayanov (1888–1939), "a much admired Russian agrarian", and the German historical school of economics, which played an important role in spreading the Central-Eastern European intellectual tradition of "Narodniki". In Romania, the extensive fieldwork of the sociological school led by Bucharest University's celebrated sociologist and ethnologist Dimitrie Gusti (1880–1955) had already generated a body of knowledge on the livelihoods of peasants in agrarian communities. Georgescu-Roegen tried to give theoretical and analytical representations this collection of historical and empirical studies on the institutional features of non-capitalistic economies.

His work on agrarian economies analyzed in detail the institutional features present in the background of economic activity in peasant communities, which are regarded as irrational from the axiom of neoclassical economics. These institutional features include the social factors of preference formation, multiple systems of land ownership, and the geographical composition of peasant villages. Form his subsequent

engagement with bioeconomics, his analysis on the fundamental difference between agriculture and industry was especially important. Georgescu-Roegen argued that the basis of the difference between 'the philosophy of the industrial town and of the agricultural countryside' is 'the fact that the living nature imposes a different type of restriction upon *homo agiricola* than the inert matter upon *homo faber'* (Georgescu-Roegen 1960, p.363). He focused on the difference between 1) the scale and space of production, 2) the function of time and rhythm, and 3) the use of energy in order to analyse in detail the agricultural and industrial production processes. In particular, he emphasized that the essential difference between the structures of agricultural and industrial production processes was related to the form of energy used in the respective production activities. That is, the decisive difference is that industrial production uses stocks of coal and oil stored in the earth's crust, while agricultural production depends overwhelmingly on solar energy flow.

> [T]here is a difference between the two sectors which touches the root of the much-discussed law of decreasing returns (in the evolutionary sense). For industrial uses man has been able to harness one source of energy after another, from the wind to the atom, but for the type of energy that needed by life itself, he is still wholly dependent on the most 'primitive' source, the animals and plants around him. (Georgescu-Roegen 1960, p.364).

By relying on fossil fuels and mineral resources in the earth's crust, the concept of *homo faber* means humans can, in principle, choose when to use these resources. In extreme terms, it would not be impossible to exhaust all underground coal and burn it within a year. In contrast, *homo agricola*'s use of the sun's energy is restricted by time, depending on the position of the earth in the solar system, and these times are not necessarily desirable for the economic actor in question. The start of the agricultural production process is dictated by nature and, specifically, by local climatic conditions. These climatic conditions are determined by the position and rotation of the earth in relation to the sun, as well as the geographical distribution of land and water on the earth's surface. Furthermore, all life on earth depends on energy from the sun, and the cyclical rhythm by which the sun's energy reaches each part of the earth is embedded in the reproductive pattern of each living species, be it plant or animal. Thus, the only net capable of capturing the flow of solar energy is land, but it is impossible to control the energy flow other than by indirect means, such as soil improvement and ground surface management, using agricultural practices such as deep ploughing, crop rotation, and manure.

This was all set out in *The Entropy Law and The Economic Process* as follows:

‘although nature is the partner of man in every productive activity, this partnership is more stringent and more subtle in husbandry than in all other sectors’ (Georgescu-Roegen 1971, p.297). However, this distinction becomes blurred with the modernization of agriculture. With the growing pressure of population growth, agricultural machines have taken the place of people and animals, and chemical fertilizers have replaced manure and fallow land. As a result, the dependence on resources from the earth’s crust has expanded into agriculture too. However, fossil fuels are also, in a permanent sense, a source of solar energy, and are critical to the operation of the plant kingdom over the ultra-long term. Thus, the industrialization of agricultural techniques does not necessarily promise liberation from the land. Georgescu-Roegen later argued that “this modern agricultural technique is in the long run a move against most elementary bioeconomic interest of the human species”. This is because the only way to substitute for the perpetual flow of solar energy is through the even scarcer stocks accumulated in the earth’s crust (Georgescu-Roegen 1975, p.373, cf. Mayumi 1991).

In his institutional analyses of agrarian economies in the 1960s, Georgescu-Roegen studied the structure of economic systems outside of a capitalist society and confirmed the limits of both neoclassical and Marxian economics, which are based on an implicit assumption of an industrialized civil society. At the same time, he was also aware of the universal horizons of human economy as a biological process, which he referred to as a ‘continuous struggle with the effects of the Entropy Law’ (Georgescu-Roegen 1969a, p.525). In “The Institutional Aspects of Peasant Communities” (1965), he was already anticipating the clear need for an epistemological shift to an economics informed by thermodynamics:

> [I]n the impasse reached by the peasant economies the biological has burst through its economic shell and now demands recognition by whoever approaches the problem. And this demand cannot possibly be satisfied with the aid of standard economic analysis alone. For some reason or other this analysis views the economic process as a mechanical analogue, i.e. as a circular motion between production and consumption. A biological process, on the contrary, is irreversible, not circular. Moreover, if instead of artificially reducing the economic process to a closed mechanical system, as we have done ever since Jevons and Walras, we carefully consider all its material aspects, we must arrive at the conclusion that this process is only an extension of the biological evolution of the human species. Like any biological process, the economic process, too, cannot create or destroy energy matter. Both are irreversible processes because both are only consumption process as far as their material

nature is concerned.

> Any material process associated with life consumes low entropy—the term by which thermodynamics covers free (usable) energy and material structures arranged in some regular patterns. It transforms the input of low entropy into an output of high entropy, i.e. into dissipated (unusable) energy and valueless waste. The important point is that the real product of such a process is not material, but a pure *flux*—the enjoyment of life by the corresponding life-bearing entity. (Georgescu-Roegen 1969b, pp.88-89)

This passage already expresses in a broadly complete form the main elements of bioeconomics that he would later go on to develop fully. For Georgescu-Roegen, the next task was to analyse the significance of understanding the economic process as part of a biological process, for both the methodology and epistemology of economics. The first product of his direct engagement with this task was a lengthy introduction titled "Some Orientation Issues in Economics" in *Analytical Economics* (1966). *The Entropy Law and The Economic Process*, which was published five years later, expanded on this introduction.

We have seen so far that the evolution of Georgescu-Roegen's bioeconomics was coupled with an anti-mechanics and anti-mechanism view of nature, brought about by the development of thermodynamics, and the intellectual legacy of the historical school which emphasized the cultural and institutional diversity of human economy. For Georgescu-Roegen, the fundamental faults in both the orthodox economics and the industrialized civil society lay in a generalization of industrial principles that ignored the characteristics of an agricultural sector possessing a subtle relationship with nature. Thus, it followed that it was necessary to find an alternative form of economic development rooted in a fundamental awareness of land and water, which are indispensable for the reproduction of life. The work of Tamanoi from the 1970s onwards builds on the task proposed by Georgescu-Roegen.

3. Economics of the living system

In Japan, with the same awareness of issues, Yoshiro Tamanoi was exploring an alternative theory of economics. Initially, this was undertaken independently of Georgescu-Roegen, but it occurred during much the same period. Tamanoi launched his own research career in the history of economics, where, during the 1950s, he was engaged in research on the history of economic thought, primarily from Ricardo through to Marx. His time at Harvard University (1958–1960) served to expand his research interests to include neoclassical economics. During the 1960s, his research focused on the theoretical bridge between Marxian economics and neoclassical

economics, as well as the related comparative economic systems. However, against a backdrop of the increasing severe pollution, as well as environmental and resource-related issues during the 1960s and 1970s, Tamanoi's research underwent a significant change of direction. According to Tamanoi, orthodox economics including the Neoclassical and Marxian (i.e. economics in the narrow sense) involved a pure analysis of the market and industry. However, such economics was not capable of understanding the reality of pollutants and large volumes of difficult-to-process waste generated by industrial production damaging the fundamental conditions for human and all life. Even socialism, which managed to achieve full employment and a robust welfare system, also will comes up against the fundamental problem of industrialization, as far as it adhere to the aim of "productionism". In order to respond to this new challenge, starting with the article titled as "Towards the Economics in the Wider Sense Based on Metabolism" (written in Japanese) in 1974, Tamanoi settled his focus on the concept of the "living system". Here, he concentrated on "economics in the wider sense", considering the human economy as a whole, based on human metabolic process with nature. In 1983, Tamanoi led the establishment of the Society for Studies on Entropy in Japan, and invited Georgescu-Roegen to be an honorary member. Interestingly, in developing of economics in the wider sense, Tamanoi focused on the significance of communities and non-market economy, which the German historical school and Polanyi identified as missing from the analysis of orthodox economics. On this point, there was a significant overlap in interests between Tamanoi and Georgescu-Roegen.

Karl Marx was the first to argue that there was a metabolic process with nature at the root of human self-reproduction, Marx did not necessary develop this process of metabolism sufficiently. Tamanoi investigated the significance of people's metabolic process with nature in reproducing their livelihood, by drawing on physicist Erwin Schrödinger's (1887–1961) concept of life, as well as on biophysical economic theory, pioneered by thinkers such as Georgescu-Roegen, Kenneth Boulding (1910-1993), and Barry Commoner (1917-2012). In particular, Tamanoi drew on Schrödinger's *What is Life* (1944) to define a living system as one that "maintains a stationary state by discarding excess entropy generated in the course of living" (Tamanoi 1990a, p.151). Living organisms constantly maximize this entropy over an irreversible period, but they manage to evade breakdown through metabolism with their environment by constantly absorbing and excreting food. To be sustainable, living systems have an absolute need for an 'external' in which to discard surplus entropy generated internally. In other words, the existence of a living system is conditional on an "eco-system" composed of (1) green plants that use the sun's energy to convert inorganic substances into organic substances (i.e. producers), (2) animals that use other organisms as a

source of nutrients (i.e. consumers), and (3) micro-organisms that break down dead animals and plants and the excretions from animals, converting them back into inorganic substances (Tamanoi 1974a, Figure 1).

Humans are a biological species, enjoying life and interacting with such living systems. Therefore, the human economy needs to be understood not as a reversible repetition of commodity ‘production’ and ‘consumption’ in a market economy, but rather as “a cyclical system of a continuous series of processes involving energy conversion, material input and processing, final consumption and waste disposal” (Tamanoi 1974a). By applying the concept of entropy to the economic process, Tamanoi understood theoretically that the (positive) industrial production process of manufacturing raw materials with technology is only possible through the (negative) irreversible qualitative deterioration of good quality energy and materials (low entropy source) into unusable waste material and waste heat (high entropy source) (Figure 2). Thus, it became possible to understand, in principle, the ecological crisis as an inevitable consequence of the economic development of the industrial civilization following the Industrial Revolution at the late 18th century. In other words, as is the case for the reproduction of living organisms, a human economy is only sustainable to the extent that it meets the conditions for the existence of a living system.

This meant that economics in the wider sense needed to engage with the challenge of consciously constructing a human economy based on the principles of a living system. For Tamanoi at this time, in the same way as for Georgescu-Roegen, it was important to bring to the fore the fundamental difference between “industry” and “agriculture”, which had been lost in the theoretical development of economics in the narrow sense. Tamanoi viewed the 1922 work of Eduard David (1863–1930), *Sozialismus und Landwirtschaft* (*Socialism and Agriculture*), as highly significant. David was an economist affiliated with the Social Democratic Party of Germany. Tamanoi described the difference between organic production and mechanical production as follows:

> In organic production, there is “the development of living things”, and in mechanical production, there is “the processing of dead objects”. The latter involves the fit-for-purpose intention of man affecting the separation and binding of entities necessary for production, through the use of intermediates whose transformation remains without intention. By contrast, in agriculture, man – as the producer – has to entrust the separation and binding to the autonomous effect of “living nature”. Because, here, it is “living nature” that is the direct producer; human labour occupies nothing more than a secondary

position. Thus, the production of industrial commodities is a mechanical process, and agricultural production is an organic process. (Tamanoi 1976a, pp.78-9)

Agricultural labour does no more than prepare for and supplement "the flow of plant and animal life". Labour that is useful for organic production differs from the mechanical process in that it is often intermittent, and the type of labour changes with each interruption. The start and end of production is determined by nature, and the tempo of the continuation of the production process is also determined by nature. For Tamanoi, the body of economic theories (in the narrow sense) was only established when this qualitative difference between industry and agriculture was abstracted. This became possible when the market economy was first disembedded from society at the end of the 18th century as the foundation for industry, separate from agriculture. Economics in the narrow sense was thought to be significant as a pure model, in principle, because it applied the same standard as industry (in terms of the commodity economy) to agricultural production. Thus, all social production was envisaged to be subsumed under the market economy (Tamanoi 1977, pp.14–5). Here, Karl Polanyi's analysis of fictitious commodities and his economic anthropological perspective were crucial in linking the problems of the subordination of agriculture to industry to the historical dynamics of the capitalistic market society, and exploring a direction that transcended the market society.

4. The conception of 'regionalism' or 'philosophy of soil'

Polanyi drew on Carl Menger's *Principles of Economics* (second edition, 1923) to divide the meaning of 'economic' into its substantive and formal meanings. The substantive meaning is derived from "man's dependence for his living upon nature and his fellows", and refers to "the interchange with his natural and social environment, in so far this results in supplying him with the means of material want satisfaction". The formal meaning is related to the rational act of making choices that originate in the scarcity of means in the means–end relationship (Polanyi 1957, p.243). Based on this categorization, Polanyi emphasized that it was only in the market society of the late 18th century onwards, when the exchange of commodities had become the norm, that the formal meaning fused and overlapped with the substantive meaning. According to Polanyi, the fiction of the market society depends on treating as commodities elements that were not originally produced as commodities, that is, humans and the natural environment as "labour power" and "land", respectively. A market society can only come into existence when these "substances of society" are violently commodified and embedded in market mechanisms through the mobilization of political power, as symbolized by the Industrial Revolution. While a market society

can only come into existence by subordinating areas that are not inherently suitable for commodification (man and nature) to market mechanisms, at the same time, this destroys its very conditions for existence, because humans and nature are not inherently commodities. Thus, Polanyi demonstrated the root of the crisis of the market economy and its lack of sustainability.

Polanyi's analysis could be said to have reconfirmed for Tamanoi that it was impossible for a market society, as the subject of economics in the narrow sense, to be completely autonomous and, therefore, the need to view a market economy and its external non-market, or marketless economy, synchronously. Moreover, Tamanoi built on this to emphasize the importance of understanding the essence of the market economy as industrialization in terms of his analysis of the essential differences between agriculture and industry. For Tamanoi, a market economy that involves the fictional commodification of humans and nature was nothing more than a society driven primarily by the logic of industry (the non-living system) that was independent and separate from an agriculture founded on the soil as a living system. According to Tamanoi, "the keynote in Polanyi's case is the call for a "return to community". But for that very reason, the image of a community reborn at a horizon beyond that of Descartes' modern world must be given greater theoretical definition" (Tamanoi 1977, p.21).

Polanyi, too, particularly from *The Great Transformation* onwards, further emphasized the problem of the Industrial Revolution and the resulting "machine or industrial civilization". It is likely that the catastrophic circumstances of the dropping of the atomic bomb on Hiroshima in 1945 was responsible for this. For example, in his 1958 work, "For a New West," he described the Industrial Revolution as "a watershed in the history of mankind", and focused on the interaction among the three forces of "technology, economic organization, and science", which supported the growth of an industrial civilization or "the Machine Age".

> The contraptions were the beginning; a movement toward a deliberate organizing of markets followed; science – almost a century later, but with an explosive effect – joined up last. All three then gathered speed: technology and science formed a partnership, economic organization made use of its chance, forcing the efficiency principle in production (both by market and planning) to vertiginous heights. Western culture is what science, technology, and economic organization, mutually reinforcing on another, unbridled and unrestrained, are making of man's life. (Polanyi 1958/2014, p.31)

What is notable here is that Polanyi understood the birth of large-scale

“contraptions” in the Industrial Revolution as preceding, and as a more fundamental phenomenon that required organizing economic markets through a self-regulating market system. In “Our Obsolete Market Mentality” (1947), Polanyi wrote as follows: “What appears to our generation as the problem of capitalism is, in reality, the far greater problem of an industrial civilization. The economic liberal is blind to this fact. In defending capitalism as an economic system, he ignores the challenge of the Machine Age” (Polanyi 1947, p.76). For Polanyi, the fundamental problems that continued after the collapse of the 19th-century market economy were the “paralyzing division of labour, standardization of life, supremacy of mechanism over organism, and organization over spontaneity”, which resulted from industrial civilization (ibid., p.59). By shifting the place of industry in society, Polanyi held up “restoring meaning and unity to life in a machine civilization” as a new challenge (Polanyi n.d./2014 p.33).

Tamanoi was also interested in overcoming the market-industrial society, but he explored in greater detail Polanyi’s question of “shifting the place of industry in society”, informed by an anti-Cartesian view of nature based on the Entropy Law. That is, he advocated reorganizing the industrial structure as a whole to restrain and control industrial production power based on the artificial processing of dead materials, taking as its basis primary industry (agriculture, forestry, and fishing), where living nature is a direct producer. This led to the crystallization of a vision of “regionalism”, where abnormal industrial production power is controlled from within, in conjunction with the market, through the reconstruction of regions and communities where humans as members of a living system reproduce their livelihood.

Rather than seeing a living system as uniform, Tamanoi consistently emphasized the creation of individual diversity displaying a local personality (*Lokalität*) based on multiple factors in each region, such as the amount of sunshine, temperature, humidity, water systems and the flow of water, flow of nutrients, and interaction with, and reaction to plants and the natural environment (Tamanoi 1976). According to Tamanoi, ecosystems in which humans’ metabolic process with nature has developed in a concrete manner are not uniform, but rather are diverse and display local personalities. Thus, an economy that depends on such ecosystems must also be diverse. This is why Tamanoi emphasized that introducing living systems and ecosystems into existing social and economic systems is the same as introducing the perspective of regionalism.

Strongly reflected in Tamanoi’s emphasis on the diversity of the ecosystems making up regions is an interest in the spatial and geographical conditions that give rise to various regional differences, which he identified particularly in the German historical school. In the early 1970s, alongside the issue of economy and ecology,

Tamanoi focused on the region and geographical space, which the historical school of economics defines differently in terms of a national economy (Tamanoi 1974b; 1976b). In assessing the function of the mutual aid organizations (*Genossenschaft*), evident in the cities and agrarian communities of Western Europe during the Middle Ages, he became aware of the need to re-examine regional societies and their highly individual climates as economically independent units, instead of as a market society expanding infinitely as a homogeneous space (Tamanoi 1975). For Tamanoi, regionalism is the idea and practice that "inhabitants of a region have a sense of unity within their regional society or community, backed by its nature, history, and landscape, and pursue administrative and political autonomy and cultural independence based on economic independence" (Tamanoi 1974a, p.60). This involves consciously fostering intermediate organizations as spaces in which to maintain living systems in order to create a kind of bond between agriculture and industry, thus protecting human livelihood from market systems driven by industrial principles. It seems that Tamanoi's interest in decentralized economic systems based on diverse intermediate organizations resonates with the idea of decentralized Guild Socialism (which Polanyi termed "functional socialism") proposed by Polanyi in the 1920s as an alternative to the market society.

When Tamanoi retired from Tokyo University in 1978, he changed his research focus to Okinawa, and engaged in a more concrete practice of regionalism. It was also at this time that his friendship with Ivan Illich (1926–2002) began. He established the Okinawa Regionalism Association in 1978, and from then on, developed "the island regeneration movement" in all regions of Okinawa's main island, and then later on islands such as Miyako, Ishigaki, and Iriomote. As Illich commented, the originality of Tamanoi's economics of the living system lay in his conception of "philosophy of soil" rooted in a culturally shaped local soil–water matrix, which is mediated by the historical and institutional diversity of the economy.

> Tamanoi made me understand that it is possible to include soil, water, and sun in philosophical anthropology, to speak of a 'philosophy of soil'. After my conversations with him I rediscovered Paracelsus, who calls for the same approach. A philosophy of soil starts from the certainty that reason is worthless without a reciprocal shaping of norms and tangible reality; seeing the culturally shaped body cum 'environment' as it is in a concrete place and time. And this interaction is formed by aesthetic and moral style as much as by the 'spirits' which ritual and art evoke from the earthly matrix of a place. (Illich 1992, p.72)

In Tamanoi's "philosophy of soil", we can find an interesting theoretical and

practical development of Georgescu-Roegen's and Polanyi's economic thought in Japan.

5. Conclusion

In this paper, we have investigated the issues on 'economy and ecology' in the economics of the late 20th century by focusing primarily on the works of Georgescu-Roegen and Tamanoi. For both, the theme of economy and ecology, which surfaced against the backdrop of the large-scale environmental pollution and energy crisis, thrusted a number of issues into the realm of economics. We can find common important concerns in their works. They both investigated the fundamental difference between "industry" and "agriculture" which had been lost in the theoretical development of economics in the narrow sense, from the perspective of the Entropy Law. For them, the market society developed after the Industrial Revolution was nothing more than a society driven primarily by the logic of industry that was independent and separate from an agriculture founded on the soil as a living system. In the same way, the fundamental faults in the neoclassical and Marxian economics formed in the late 19th century lay in a generalization of industrial principles that ignored the characteristics of an agricultural sector possessing a subtle relationship with nature. Therefore it was important task for them to find an alternative form of economic development rooted in a fundamental awareness of land and water, which are indispensable for the reproduction of a living system. Within such context, Tamanoi investigated a series of problems derived from the fictional commodification of humans and nature in the market economy, which was posed by Polanyi. But as we have identified in some articles after writing *the Great Transformation*, Polanyi was also clearly aware of the crisis of the market society as "the far greater problem of an industrial civilization" or "Machinery Age". We will need to explorer the potentiality of Polanyi's economic thought from this point of view.

Figure 1: the System of Economy=Ecology (Tamanoi 1976)

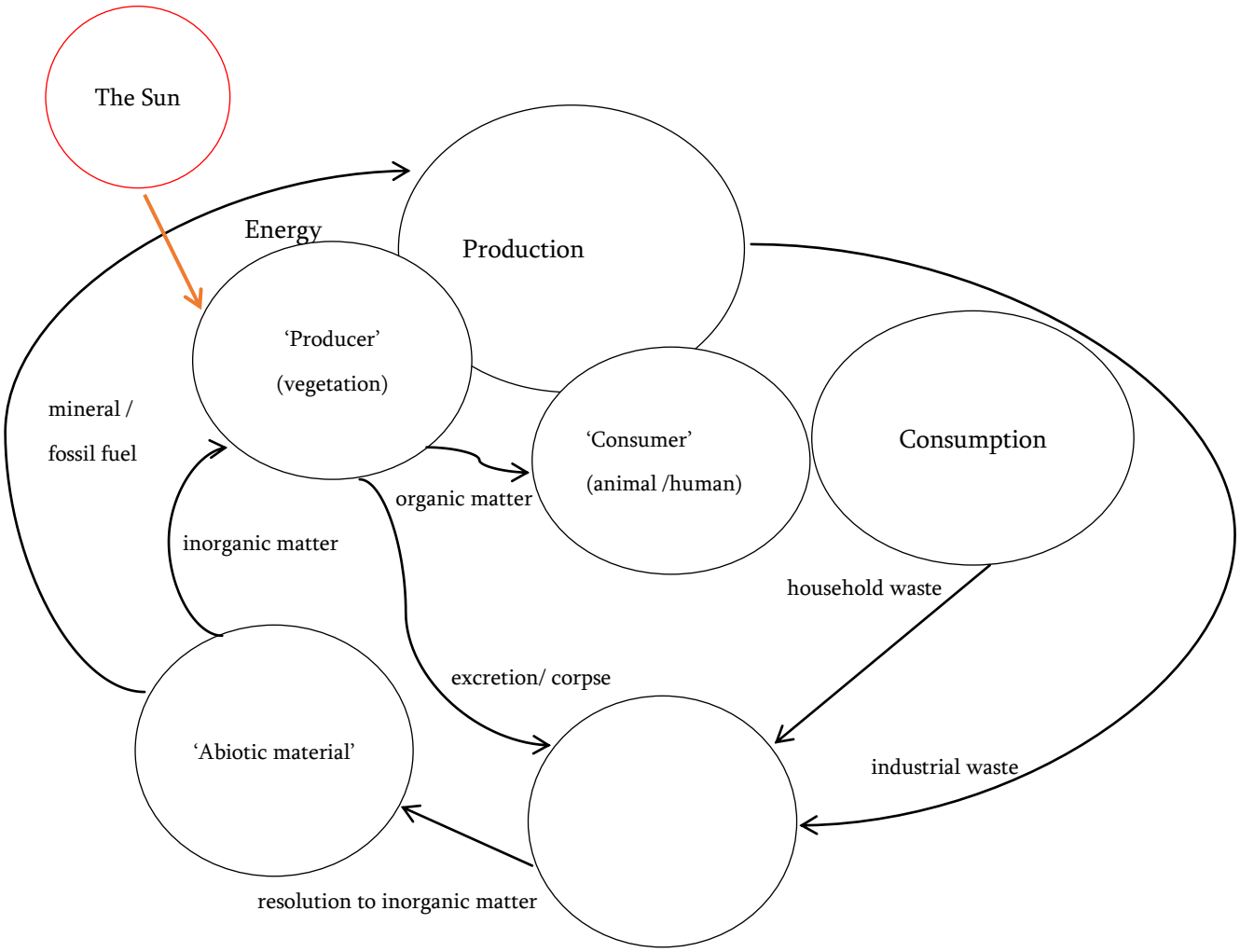
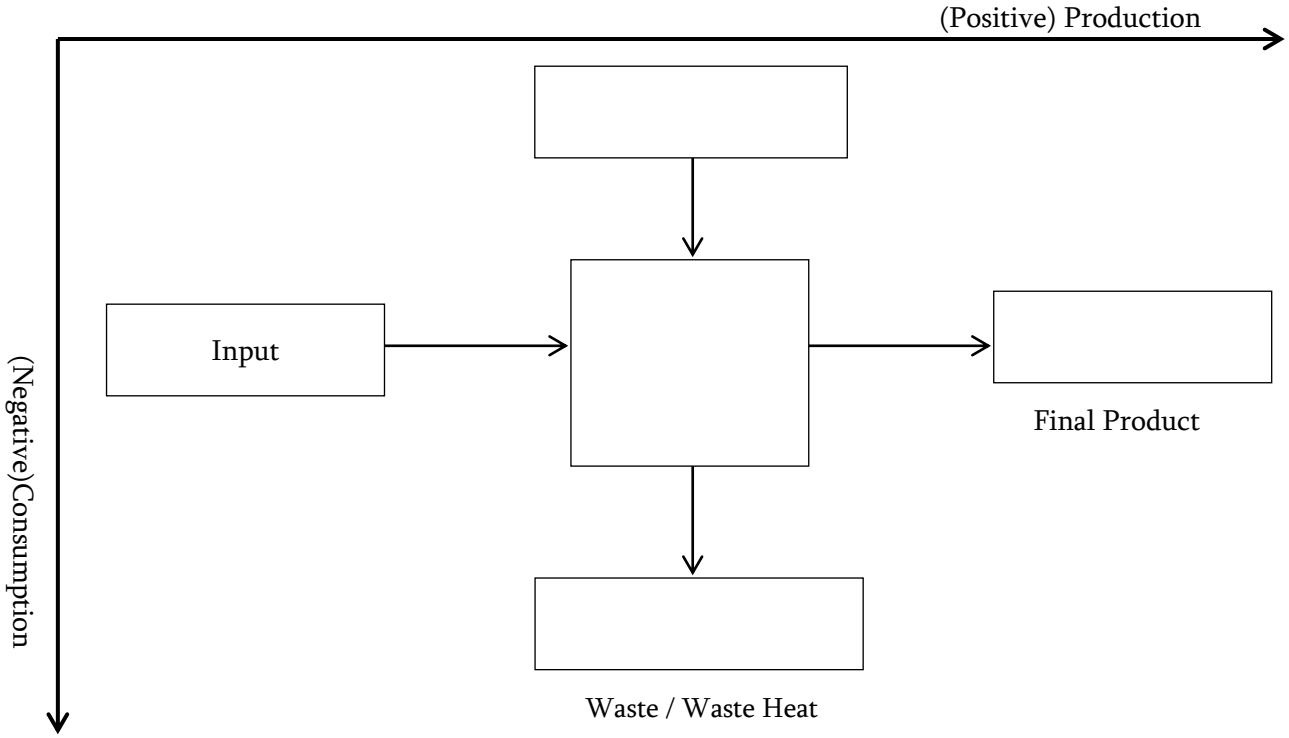


Figure 2: The Basic Model of Productive Process (Tamanoi 1982)



References

Christensen, P. P. 1989, ‘Historical Roots for Ecological Economics: Biophysical versus Allocative Approaches’, *Ecological Economics*, 1: 17–36.

Cleveland, Cutler J. 1987, ‘Biophysical Economics: Historical Perspective and Current Research Trends’, *Ecological Modelling*, 38: 47–73.

Georgescu-Roegen, N. 1960, ‘Economic Theory and Agrarian Economics’, *Oxford Economic Papers*, XII, in *Analytical Economics*, 359–397.

—— 1966, *Analytical Economics*, Cambridge, MA: Harvard University Press.

——1969a, ‘Process in Farming versus Process in Manufacturing’, in U. Papi and C. Nunn (eds.), *Economic Problems of Agriculture in Industrial Societies*, London: Macmillan, 497–528.

——1969b, ‘The Institutional Aspects of Peasant Communities: An Analytical View’, in Wharton C.R. Jr. (ed.), *Subsistence Agriculture and Economic Development*, Proceedings of an International Seminar, Honolulu, 1965, Aldine Publishing Company, Chicago, 61–99.

——1971, *The Entropy Law and The Economic Process*, Harvard University Press.

——1975, ‘Energy and Economic Myths’, *The Southern Economic Journal*, 141/3: 347–381.

——1976, *Energy and Economic Myths: Institutional and Analytical Economic Essays*, New York: Pergamon Press.

——1992, ‘Nicholas Georgescu-Roegen about Himself’, in Szenberg M. (ed.), *Eminent Economists and their Life Philosophies*, Cambridge: Cambridge University Press, 128–160.

Illich, I. 1992, ‘Disvalue (Lecture to the first public meeting of the Entropy Society)’, in *In the Mirror of the Past, Lectures and Addresses 1978–1990*, London: Marion Boyars.

Martinez-Alier, J. with Schlüpmann, K. 1990, *Ecological Economics: Energy, Environment and Society*, Oxford: Blackwell (with a new introduction).

Mayumi, K. 1991 ‘Temporary Emancipation from Land: form the Industrial Revolution to the Present Time,’ *Ecological Economics*, 4, pp.35-56.

Mirowski, P. 1988, ‘Energy and Energetics in Economic Theory’, *Journal of Economic Issues*, 22/3: 811–830.

Polanyi, K. 1947, ‘Our Obsolete Market Mentality’, in G. Dalton (ed.), *Primitive, Archaic, and Modern Economics*, Beacon Press.

——1957, ‘The Economy as Instituted Process’, in Polanyi et al. (eds.), *Trade and Market in the Early Empires*, The Free Press.

——1958, ‘For a New West’, in Polanyi 2014.

——1975, *Keizai no Bunmeishi* (in Japanese), edited and translated by Y. Tamanoi and K. Hirano, Tokyo: Nihon Keizai Shinbunsya.
——2014, *For a New West: Essays, 1919–1958*, edited by G. Resta and M. Catanzariti, Cambridge: Polity Press.
——n.d. 'Economics and the Freedom to Shape Our Social Destiny', in Polanyi 2014.
Schabas, M. 2005 *The Natural Origins of Economics*, Chicago: Chicago University Press.
Tamanoi, Y. 1974a, 'Bussitsu taisya no kougi no Keizaigaku wo mezashite' (Towards the Economics in the Wider Sense Based on Metabolism), in Tamanoi 1978.
——1974b, 'Doitsu keizaigaku no dentou' (The tradition of the German Economics), in Tamanoi 1978.
——1975, 'Herrschaft and Genossenschaft' (written in Japanese), in Tamanoi 1978.
——1976a, 'Economy and Ecology' (written in Japanese), in Tamanoi 1978.
——1976b, 'Doitsu rekishi gakuha keizaigaku saihou' (Rethinking the German Historical School of economics), in Tamanoi 1978.
——1977, 'Shakai kagaku ni okeru seimei no sekai' (The life world in social science), in Tamanoi 1978.
——1978, *Economy and Ecology* (written in Japanese), Tokyo: Misuzu Shobo.
——1982, *Seimeikei no Ekonomī* (*Economy of the Living System*), Tokyo: Sinhyoron.