

On the Cyclical Division of Labour and its Fractal Structure

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富山大学紀要. 富大經濟論集 第64卷第1号抜刷 (2018年7月)

富山大学経済学部

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Abstract

In all theories of the division of labour, labour and wealth are understood from the perspective of the market economy. Particularly, labour is used as 'production labour' and is arterial to the production processes in manufacturing industries. This study understands labour and wealth from the perspective of the cyclical society, which is composed of human reproduction, economic reproduction and natural reproduction. Then it can be examined as one complete labour process. In this way, we can examine the recycling division of labour. This report deepens and extends the understanding of this concept. Firstly, we can think of the cyclical society as constituted by the consumer as the human subject, the producer as the economic subject and the decomposer as the natural subject (CPD). Secondly, in the 'virtuous cycle society', the division of labour is developed with similar structure, CPD. Thirdly, in the 'vicious cycle society', the division of labour is developed with little or no 'decomposer labour' (CPd). Fourthly, the necessary conditions for the formation of the virtuous recycling division of labour are explored with respect to the expansion of 'zero desire', 'eco-consumption', 'eco-management' and 'zero industry'. a factor

Key Word: Cyclical society, Cyclical division of labour, Fractal structure, Zero desire, Zero industry

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1. Introduction

This paper introduces a new analytical framework for the division of labour that incorporates the international division of labour. The main thrust of the concept will follow from the key insights expressed below. The keynote is the cyclical division of labour¹ and its fractal structure² in the circulation society³.

1.1. *The perspective of the theories of division of labour*

The division of labour is as old as human civilisation. The first recorded discussions of the division of labour, example ‘Four Occupations’ or ‘Four Categories of the People’(simplified Chinese: 四民分业 ; traditional Chinese: 四民分業) are from the 8th century BC classical legalist chancellor and scholar, Guan Zhong, from the State of Qi, situated on the east coast of modern-day China. Theories of the theory about social division of work or the international division of labour have evolved from the Axial Age, with the

1 LONG Shixiang, ‘On the Cyclical International Division of Labour’ *Joint International Symposium of the Northeast Asia Economic Association of Korea and the Association for Northeast Asia Regional Studies (of Japan)*, August 25-27 2010, Donghae City, South Korea.

LONG Shixiang, ‘International Low Carbon Society and International Eco-Compensation: by Viewpoint of Circulation Society’ *Proceeding of the 2010 International Conference of Asia-Pacific Low Carbon Economy (GEMI2010) & 9th Northeast Asian (NAAN9th)*, November 26-27, 2010, Changsha, China.

2 LONG Shixiang, ‘On the Cyclical Division of Labour and its Fractal Structure’ *The 14th Asia Pacific Industrial Engineering and Management Systems Conference (APIEMS 2013)*, December 3-6, 2013, Cebu, Philippines.

LONG Shixiang, ‘On the Viewpoint of Cyclical Division of Labour’ *Proceeding of the 2013 International Conference on Green Economy and Management Innovation (GEMI2013) & 12th Northeast Asian (NAAN12th)*, May 24-26, 2013, Changsha, China.

3 LONG Shixiang, *Theory of Recycling Society* kouyou books (Japan), Jun 2002 (in Japanese).

'Writings of Master Guan' (*Guan Zi*)⁴ having been compiled mostly in the 4th century BC and edited in the Han Dynasty in 26 BC. Ancient Greek thought on the subject was typified in *The Republic* by Plato⁵ and 'Oeconomicus' by Xenophon⁶. In the modern era, Karl Marx cited William Petty who was the first modern writer to take note of division of labour in economics as 'the founder of the political economy' and historians of political economy trace the roots of the classical liberal economics of Adam Smith and David Ricardo to Petty's work in the latter half of the 17th century.⁷ The division of labour theory is the theoretical foundation of classical economics constructed by them. Marx's theoretical contributions are his sharp distinction between the economic division of labour that is purely due to "technical necessity" (forces of production) and the social division of labour are a result of a "social control" (relations of production) by *Capital: Critique of Political Economy*.⁸ In Alfred Marshall's approach of Industrial organization theory by *Principles of Economics*⁹, division of labour is the main engine of growth and plays a central role in capital accumulation and technological progress. However in the neoclassical economics before Alfred Marshall and Marxian economics before Karl Marx *Capital*, the division of labour theory was abandoned. The new-classical economics of Allyn Young and Xiao-kai Yang¹⁰ have advanced

4 *Guan Zi*, Warring States - Han (475 BC - 220), Chinese Text Project Simplified Chinese version.

<https://ctext.org/guanzi/ens>

5 [https://en.wikipedia.org/wiki/Republic_\(Plato\)](https://en.wikipedia.org/wiki/Republic_(Plato))

6 <https://en.wikipedia.org/wiki/Oeconomicus>

7 https://en.wikipedia.org/wiki/Division_of_labour#cite_ref-15

8 Volume I Part Four: The Production of Relative Surplus-Value.

9 Book IV. The Agents of Production. Land, Labour, Capital and Organization.

10 Xiaokai Yang, *Economics: New Classical versus Neoclassical Frameworks*, New York, 2001.

the field through the 20th century.¹¹

A retrospective categorisation of the developments in the field of the international division of labour provides the theoretical handles by which the field has been gradually pried open: the morphological (or pattern/feature analysis), the genetic analysis, the affect analysis, and the value (or division of earning) analysis.

From the above discussion, it is possible to draw the conclusion that, as the most fundamental concept in all theories of the division of labour, 'labour' and 'wealth' are understood from the perspective of the market economy. Particularly, the labour to which the division pertains is used as 'production labour' and is arterial to the production processes in manufacturing industries.

1.2. The new challenges

Some of the most testing problems of modern society, such as the destruction of the natural environment and growing economic disparity, are intensifying as globalisation spreads. One common interpretation is that this is a 'vicious cycle society'. The new international socio-economic system must deal with these problems, which are forming across many various aspects of the system, and our present socio-economic system is undergoing inexorable changes. The environmental consciousness of the economic sphere is growing and with it, environmental industries are expanding. This can be interpreted as the formation of a 'virtuous circle society' that is striving to find a new way to solve the problems of modern society.

Moving forward, the environmental economics study must answer the

11 LONG Shixiang, 'On the Cyclical Division of Labour and its Fractal Structure' *14th Asia Pacific Industrial Engineering and Management Systems Conference (APIEMS 2013)* (Cebu Philippines), 4 Dec 2013 (in Japanese).

following problems: In the process of this social change, what is the situation of the division of labour? How does it function? How is it changing? It is necessary to understand 'labour' and 'wealth' from the perspective of the cyclical society. The questions should incorporate the arterial 'production labour' used in the manufacturing industries and introduce the metaphorical artery wall as well as vein, then it can be examined as one complete labour process. In this way, we can examine the recycling division of labour. This report deepens and extends the understanding of this concept.

1.3. The new analytical framework of my study

Firstly, in Section 2 it is necessary to draw out the meaning of labour and the primary division of labour in the cyclical society. Then, in Section 3 deeper elements will be shown: the primary factors in the division of labour, the historical classifications of the cyclical society, and how it changes according to a fractal structure of the primary division of labour. The role of the destruction of labour is examined in the switching process from the 'vicious cycle society' to the 'virtuous cycle society'. Then the concept of the primary division of labour across East Asia is addressed at the end of Section 2. In Section 3, the necessary conditions for the formation of the recycling division of labour are explored with respect to the expansion of 'zero desire'¹², 'eco-consumption', and 'eco-management' in industrial activities and how the industrial structure morphs to accommodate environmental industrialism. This analysis of the recycling division of labour is arranged with respect to companies and societies. Section 4 gives a factor analysis of the international dimension. Section 5 discusses the value structures in the recycling

12 LONG Shixiang, 'Desire and Zero Desire' *Journal of Kanazawa University of Economics* (Kanazawa University of Economics, Japan), Vol.35, No.1, July 2001, pp35-46.

international division of labour. Here, the issues of profit- and cost-sharing are discussed, and economic externalities are introduced into the analysis.

2. The labour and primary division of labour in the cyclical society: a basic angle for research on the cyclical division of labour

2.1. The configuration of labour in the cyclical society

The main aim of this section is to offer a new perspective on the origins and limitations of the division of labour, which aims to reformulate the cyclical society to include labour.

To abstractly reinterpret reproduction processes in the economy, it is necessary to study a problem arising in the division of labour in the modern socio-economic system. This analysis draws on the metaphor of natural systems to reinterpret social systems. Thus, the ‘metabolic process’ of natural and social systems has two sides. The first side consists of the direct intake of consumer goods during ‘the production processes of human (society)’ and the indirect intake of natural resources via ‘the production processes of economy’; analogously, this system ‘produces’ (or discharges) waste which nature then ‘consumes’. The second side consists of the direct and indirect intake of natural resources by ‘the production processes of economy’ and the discharge to nature of production waste (see Figure 1).¹³

13 LONG Shixiang, ‘The Logical Evolution of an Industrial Structure Leading to Destruction of the Natural Environment’ *Socio-Environmental Studies* (Graduate School of Socio-Environmental Studies Kanazawa University), No.1, March 1996, pp.83-98 (in Japanese).

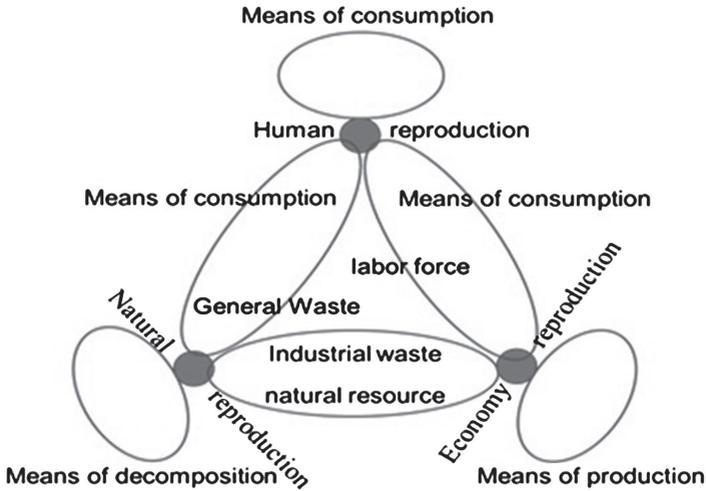


Figure 1 *The Material Structure of the Cyclical Society*

It is important to stress that ‘society’ must be divided into ‘human reproduction’ and ‘economic reproduction’ when thinking about what constitutes the broad spectrum of economic reproduction processes. The key is human independence. In other words, this broad spectrum of economic reproduction processes consists of human, economic and natural reproduction processes. A complete image can be grasped if interactions between elementary particles are considered. Generally, the elements are energy, matter and information. Production processes are constituted of the main parts. They are the consumer as the subject of human reproduction processes, the producer as the subject of economic reproduction processes, and the decomposer as the subject of natural reproduction processes.

The working definition of labour is as follows: labour is the aggregate of all human physical and mental effort used in the creation of goods and services and is a primary factor of production. We can expand the concept

of the labour as follows when we apply this definition to the cyclical society: labour is the aggregate of all subjects of production processes' effort used in the creation of goods and services and is a primary factor for all production.

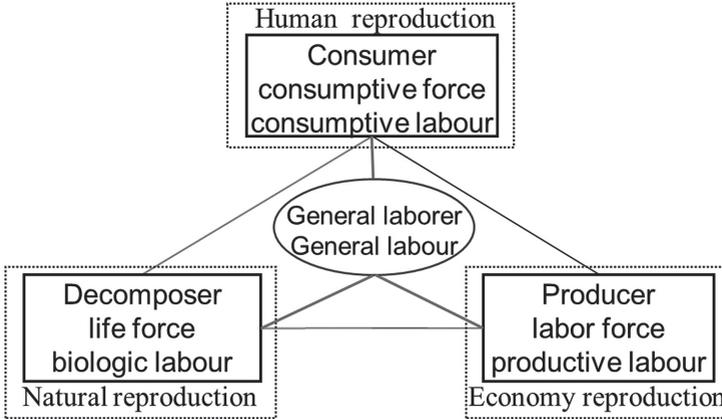


Figure 2 *The Cyclical Society and General Labour*

The labour of the producer in the economic reproduction processes is comprised of biological labour, driven by life force, a consuming labour driven by consuming force, and productive labour driven by labour force. Unpacking these reveals two concepts. Biological labour, consuming labour and productive labour are all done at about the same time and the same local position. Theoretically, the three labours are gone at different locations (see Figure 2).

In this paper, the primary meaning of the cyclical division of labour is the division of labour from the perspective of the cyclical society that is shown in Figure 1. The division of labour called ‘general labour’ during the interaction of the three cyclical social reproductive processes of the cyclical society. This is referred to as the ‘primary division of labour’ and is represented in Figure 2.

2.2. *Productive labour in the cyclical society*

Extending the concept, productive labour in the cyclical society is a union of the activities that an individual production constituent functionalises and a specific input factor and output factor through the use of the labour force. It can have a specific influence on a human process, a natural process and an economic process. Exploring the implications, productive labour in the circulation society has three main properties.

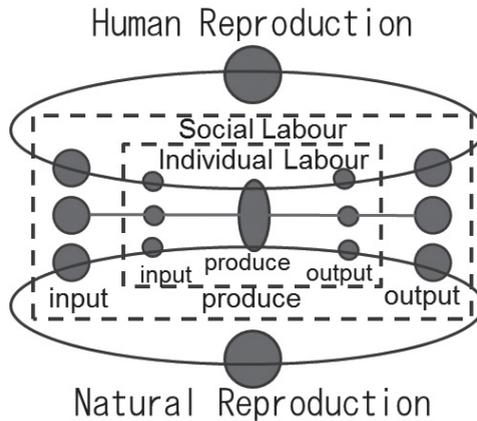


Figure 3 *The Cyclical Society and Productive Labour*

The first is to satisfy certain human desires or needs. The second property is as an input of a means of production that includes resources from humans, nature and the economy. The third is as an output or a product, a by-product or service that includes the discharge of waste into humans, nature, or the economy (see Figure 3).

At first, it is prescribed in output element structure included natural producer goods and input element structure included the waste. Then,

labour is related to three cyclical social reproduction processes in three stages: a stage of input activity, a stage of production activity, and a stage of output activity. In addition, labour in the circular society is carried out along two dimensions: individual labour and social labour.

In this paper, the secondary meaning of the cyclical division of labour is the division of labour pertaining to three cycles. They are the circulation between human processes that the labour force and consumer goods transmit, the circulation between economic processes that the means of production transmit, and the circulation between natural processes that natural resources and waste transmit.

2.3. Value and wealth in the cyclical society

Adam Smith explains in *The Wealth of Nations* (1776), ‘The annual labour of every nation is the fund which originally supplies it with all the necessaries and conveniences of life which it annually consumes, and which consist always either in the immediate produce of that labour, or in what is purchased with that produce from other nations.’¹⁴ His fundamental viewpoint about value and wealth is couched in this passage. Understanding labour as ‘general labour’, we can reason that the economic process in a broader sense is motivated by three elements: the needs of human beings, the development of the productive force, and the self-regulating balance of nature. The aim of improving the economic process is to enhance quality of life, improve the effectiveness of the economy, and preserve the natural environment.

14 Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations*: Introduction and Plan of the Work. First Pub. 1776, London: Methuen & Co., Ltd. 5th edition Pub. 1904.

<http://www.econlib.org/library/Smith/smWN1.html#B.I>, Introduction and Plan of the Work

In the broad sense of the economic reproductive process, a human has three sides. For human reproductive processes, a human is a constituent that, having consumption power, becomes a human person. For economic reproductive processes, a human is a constituent that, having the work force, becomes an economic person. For nature's reproductive processes, a human is a constituent that, having vitality, becomes a natural person.

It follows that the value judgements that humans make in the cyclical society and the locational value of everything is grasped as a three-dimensional valuation of welfare value judged by humans as a human person, economic value judged by humans as an economic person, and natural value judged by humans as a natural person.

Further, wealth judgements from the perspective of the cyclical society encompass all things in which this three-dimensional human value is inherent. Sources of social wealth stem from biological labour. It is funded by productive labour. The necessity and possibility of wealth arises from consuming labour. The utility of wealth is comprised of a stock and flow style of consumption which supplies humans, the economy and nature.

In this study, directions of causality between the increase or the decrease in or the distribution of each type of wealth and the cyclical division of labour become crucial.

3. The fractal structure of the division of labour

3.1. The division of labour in nature and its fractal structure

Darwin's theory of evolution has the following to say. Nature is a complex network, full of interdependence and harmony. Every member of every

species and each species in nature occupies one office. Sometimes they are in a fierce competition of survival of the fittest. Sometimes they are in a peaceful coexistence of mutual divergence. The complicated evolution mechanism contain Coevolution, Divergence, Adaptive, Natural Selection, Convergent and Degeneration.(see Fig. 4, B) The result is the formation of the division of labour in nature, and variety has become rich. The labour in nature is herein called 'life labour'. The process of the 'division of life labour' in nature can be broken up into five stages: N0, N1, N2, N3 and N4. The N0 stage (4.5 billion years ago) was when Earth was formed in space and was able to divide the 'labour' with other stars. The N1 stage (from 3.8 billion years ago to 3.5 billion years ago) was when the eobiont formed on Earth, and the division of labour between the living and the non-living entities began. The N2 stage (from 3.5 billion years ago to 1.3 billion years ago) is called the age of bacteria and cyanobacteria, and the division of labour between the microbe as decomposer and the original body of life began. The N3 stage includes the era of eukaryotic algae and invertebrates (from 1.3 billion years ago to 440 million years ago); the era of bare fern plants and fish (from 440 million years ago to 350 million years ago); the era of ferns and amphibians (from 350 million years ago to 270 million years ago); and the era of gymnosperms and reptiles (from 270 million years ago to 70 million years ago). The division of labour between plants as producers and animals as consumers was formed in this stage. The N4 stage (from 70 million years ago to 300 million years ago) is the era of angiosperms and mammals. This stage is important for us because the natural division of labour between mammals and other animals was formed in this stage, and that was the starting point¹⁵ of the human story. (see Figure 4, C)

15 LUO Liaofu, 'Physical Aspects on Life Evolution' *Shanghai scientific & Technical Publishers* (China), Oct 2000.

The fractal structure of the primary division of labour in nature is studied based on fractal theory. In the processes of evolution, differentiation and sublimation, nature (a decomposer of the human and the economy), the entity that was able to build the division of labour in the system to achieve a purpose as an individual and a group and part of the whole. It is the division of labour between decomposer, producer, and consumer in the biological system that is supported by a non-living (or non-biological) system. In addition, the individual entity and the group entity and the entity that is the whole occupy the structure of this division of labour equally. In other words, the structure becomes like ‘a nest of boxes’ (see Figure 4).

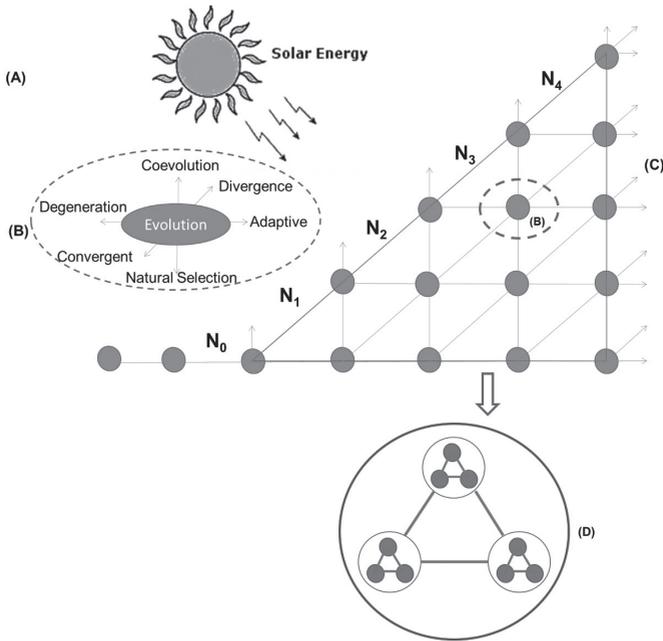


Figure 4 *The Process and the Fractal Structure (right) of the Division of Life Labour in Nature*

This division of labour is a cooperative system and is a control system of ‘autointoxication’. The ‘invisible hand’ of the division of labour system in the circulation of nature is sustainable and is a law of nature that has effectiveness and equitableness. I read it with ‘a law of the self-to-self optimisation’. This is the common DNA of the natural world.

3.2. The development of the fractal structure of the primary division of labour

When were human beings born—300 million years ago? From where did human beings originate—Africa? What is the ancestor of human beings—the ape? These matters lie outside this paper’s field of interest. What is most important is to have had the division of the conscious human labour from unconscious living entity labour.

Regardless of the local geographical differences, in primitive society, the division of labour exists both within the community and or between communities, but the ‘division of natural labour’ is limited by the natural dependence of the human being upon society. ‘The division of natural labour’ within the community is the division of labour. For example, in East Asia, ‘the domestic wife’ is reminiscent of the past division of labour by gender. In addition, ‘the division of natural labour’ between communities is a local division of labour that forms around the differences in endowments of natural resources.

In addition, the division of natural labour shares the next property. At first, production and the consumption are carried out synonymously. Then, they are not destroyed because nature provides the decomposition component. In other words, human beings perform the activity of consumption, production and decomposition alongside nature. Thus, the division of labour during this time can be called ‘primitive-recycling division of labour’ and the cyclical

society of this time can be called the 'primitive-equilibrium cyclical society'.

In the last stage of the primitive society, the transformation from the prototype cyclical society to the traditional type (agriculture type) cyclical society was achieved through 'the three stages of great social division of labour'. This is division of labour based on specialisation. This is the social division of labour based on specialisation between primitive communities. Within the community, it is achieved through the 'conventional-recycling natural division of labour', which is the separation of the consumption process from the economic process and the establishment of the division between consumption labour and production labour.

If we examine this natural production process, or the Earth's systems as one complete ecosystem consisting of producers, consumers and decomposers as described in Section 3.1, it is possible to observe this broader sense of economic reproduction, or cyclical society that exhibits fractal relations in its natural reproduction. The agricultural type of cyclical society that disrupts the natural ecosystem had this equilibrium structure. As for the cyclical relations attributed to 'economy, humanity and nature' in the circulation society, these are the cyclical relations between the 'producers, consumers, and decomposers', in accordance with the natural ecosystem. The cyclical relations between 'producer, consumer and decomposer' that is within the human is also mirrored in the economy. In other words, the fractal structure that is inherent in the cyclical division of labour has a basic rooting in nature and it has been developed in at least two dimensions here. This can be called 'traditional-equilibrium cyclical division of labour'. The cyclical society that has such a division of labour is then the 'traditional-equilibrium type circulation society'. This fractal structure is still prevalent in rice-growing practices across East Asia. 'Rice-fish', 'rice-duck', and 'the Edo model' are all examples of this (see Figure 5, B).

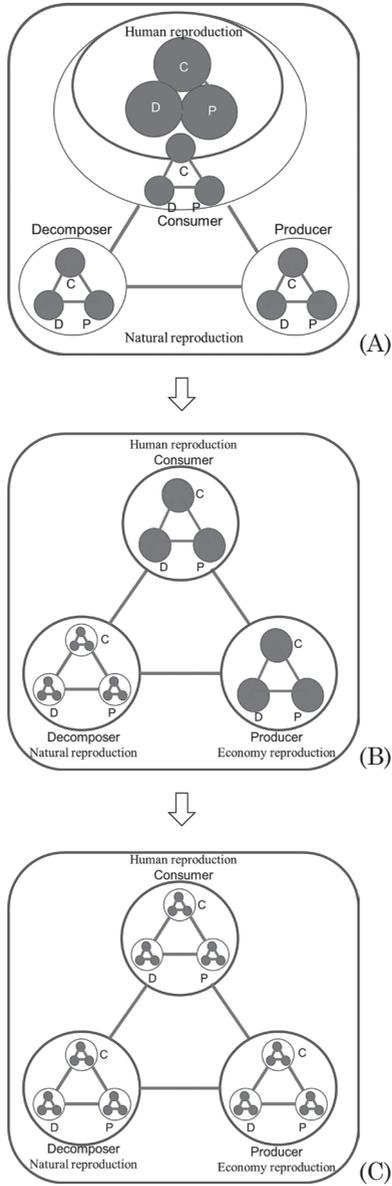


Figure 5 *The primordial type (A), traditional type (B) and futuristic type (C) of fractal structure in the primary division of labour*

In the primitive cyclical society, the natural division of labour and joint ownership of wealth is the breeding ground for ‘an exchange inclination’ and the ‘selfishness’ that Adam Smith ascribes as the cause of the division of labour. In this ‘natural division of labour’, the durability, equitableness and effectiveness are met as a basic condition for the recycling division of labour. The ‘invisible hand’ changing this ‘natural division of labour’ is the ‘DNA’ of nature and its transformation through the application of labour.

The traditional-equilibrium cyclical social ‘invisible hand’ is collaboration between the DNA of nature and its replication in settings like the farm or agricultural village. The essence here is knowing to where this ‘law of nature’ leads. If this mechanism is remains undisturbed, human society evolves into the next stage. In other words, inside the human reproduction process and the economic reproduction process, the recycling division of labour unfolds like a natural reproduction process. The structure of this now complete fractal becomes the scenario of our ideal society. This can be called the futuristic-equilibrium cyclical division of labour. This is a structural property of the futuristic-equilibrium cyclical society.

3.3. The disequilibrated development of the fractal structure of the primary division of labour

Leading from the scale of circulation, the vicious circle society consisted of the following factors: the human expansive reproduction characterised by mass consumption, the economic expansive reproduction characterised by mass production, and the natural decomposing reproduction to be characterised by mass disposal. From the perspective of circulation, as in the vicious circle structure, this has been expanded internationally to developing countries through the spread of high growth model.

The next three key points emerge as the formative factors of the reproductive structure of the vicious circle society. These are factors relating to the material aspects more than the differences in the social system. The first cause is the advancement of the industrial structure, which conduces high economic growth. The second cause is the advancement of the consumption structure or a lifestyle that aims to satisfy the expansion of and mitigate the interference with human material desires. The third cause is the advancement of the location structures, particularly of urbanisation. These three formative factors are causally linked to the vicious circle society. The contribution of these three economic structures to the vicious circle is grasped through understanding the energy, production and disposal structures.

As a result of the factors stated above, human society destroyed the environmental conditions that ensures its existence with its own hands. It is a society composed of ‘self-poisoning’ individuals. In ecosystems, self-poisoning is caused by endogenous microorganisms, metabolic waste or other toxins produced within the body.

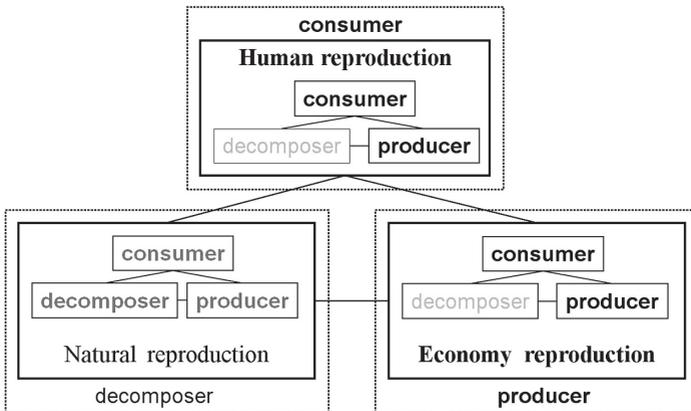


Figure 6 *The fractal structures in the disequilibrated primary division of labour*

In a vicious circle society, the society of ‘self-poisoning’ individuals is a result of the mass exploitation of natural resources that are produced within the body, or the mass consumption of human reproductive processes and mass production of economic reproductive processes. In other words, it is the disruption of the self-poisoning of the producer (economic reproduction) and the consumer (human reproduction) by the decomposer (natural reproduction). Furthermore, as for the structural causes, it is a weaker decomposer (later, ‘zero industry’, or ‘eco-consumption’) that enables the expansion of the producer (or the means of production, or ‘unproductive consumption’) and the consumer (or the means of consumption, or ‘productive consumption’) within economic or human reproduction. (see Figure 6).

3.4. The historic and realistic classification of the cyclical society and its cyclical division of labour

‘Cyclical society’ or ‘cyclical economy’ are popular when talking about societal aims. However, from the perspective of reproductive processes in the broader senses of the economy, the socio-economic structure always becomes cyclical. For clarification, the definition here and throughout is conceptually neutral.

First the cyclical society can be classified into two categories: the primitive-equilibrium cyclical society and the disequilibrium cyclical society, or ‘vicious circle society’. In section 3.2, the equilibrium cyclical society and its cyclical division of labour is classified into three types: the primitive-equilibrium that is to be characterised by natural dependence, the traditional-equilibrium that is to be characterised by natural maintenance, and the futuristic-equilibrium. In section 3.3, the vicious circle society was classified historically into the

traditional-disequilibrium cyclical society, the regional-present disequilibrium cyclical society, and the global-present disequilibrium cyclical society.

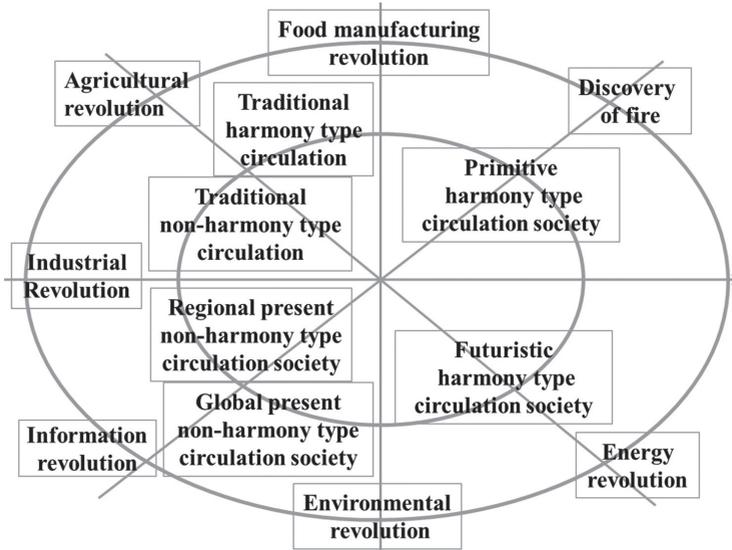


Figure 7 *The Historic Classification of the Cyclical Society and its Cyclical Division of Labour*

Figure 7 diagrams the historic change in the processes in the cyclical society and its cyclical division of labour. The birth and extinction of the Earth's ecosystem is illustrated according to its origins. What needs to be stressed here is that components of each stage are embedded in today's society. In other words, Figure 7 is also a diagram of the modern circulation society.

The formative factors of the vicious cyclical structure are nested within the development process of the structure of the vicious cyclical division of labour. The basic composition is a reduction in the decomposition labour (the weakening of the decomposer), the expansion in the productive labour

(obesity of the producer), and the expansion of the consumption labour (obesity of consumers). Then where are the formative factors of the structure of the vicious cyclical division of labour? Indeed, it has been disturbed by cyclical society's 'DNA', which has evolved from the 'DNA' of nature as mentioned above. This disturbance spreads globally. One factor causing this disturbance is the viral property that 'the supremacy of profit' has.

The aim then should be to dismantle vicious cyclical society, and it is to build the futuristic-equilibrium cyclical society. It is the ultimate aim of the cyclical society to dismantle the vicious circle and to build the futuristic-equilibrium cyclical society. It is the necessary condition then to exterminate the viral nature of capital in the cyclical division of labour at each level and to regain the spirit of the decomposer. This paper therefore prescribes the expansion of eco-management and environmental industry.

3.5. Desire and Zero desire

In the process noted above, what is most important is to have had the division of the conscious human desire from unconsciousness desire.

As natural human, it has desire similar to the animal. However, human is different from the animal, human desire is above animal's one. Human's desire is the sublimation of the wants, and is the intention of the pursuit and conscious selection generated by dissatisfaction with the way and condition to realize the human's general needs. The essential characteristics of desires are the quantitative and qualitative expansion.

Considering the human's three attitudes, desire can be classified in intention to pursue natural means and a condition and intention to pursue economy means and a condition and intention to human pursue means and a condition. In the background of the formation of industrial society,

the expansion of quantity of desire as before has been done mainly by non-interference of economic desire. The expansion of quality has been done mainly by diversification of economic desire. That is to say economic desire was subdivided by the first desire and second desire and the third desire.

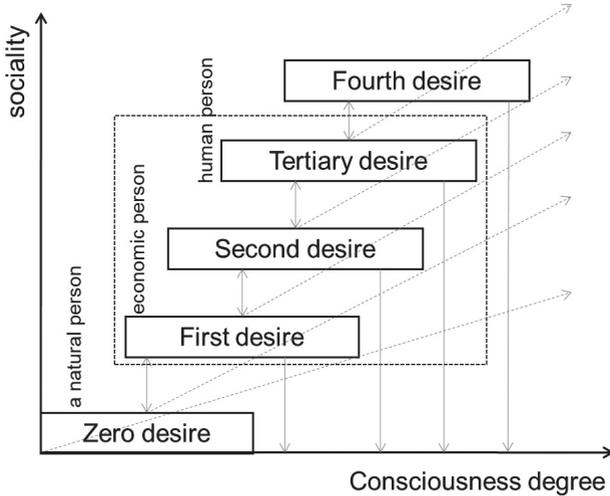


Figure 8 *Desire and Zero Desire*

With environment problem becoming intensified, human society becomes ‘Self poisoning’. Therefore, I can say that due to it, a desire of unconsciousness to depend on human nature is able to be sublimated into “desire” of consciousness. And the expansion tendency is strengthened increasingly. Improvement and diversification of people environment consciousness are the proof. It is, so to say, a driving force of “environment revolution” which consist principally the expansion of Eco-life (see Figure 9), Eco-management and Environmental industry, and the desire is named “zero desire” in this report. . (see Figure 8)

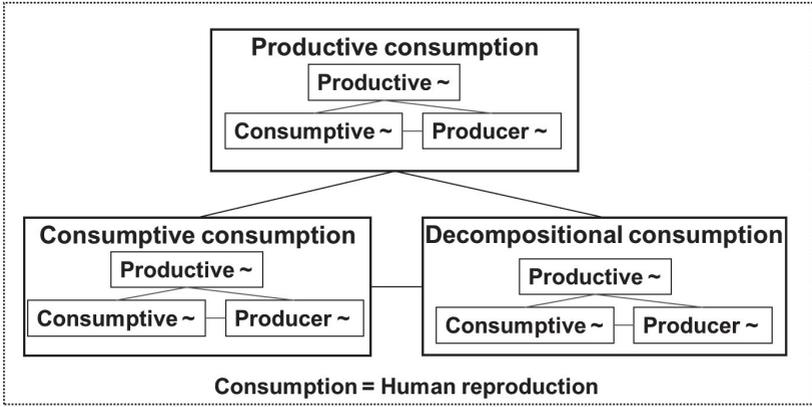


Figure 9 *Eco-life and its Fractal Structure*

4. Eco-management, Zero industry and cyclical social division of labour

4.1. The introduction of ISO14001 EMS and the formation of cyclical intra-product specialisation

An Environmental Management System [EMS] is introduced into a company to cope with the ‘external diseconomies’ in the formation of fragmentation and to pursue ‘internal economies’.

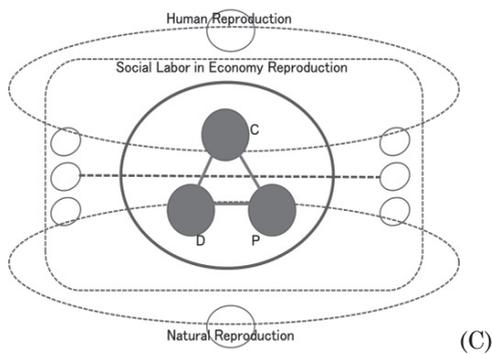
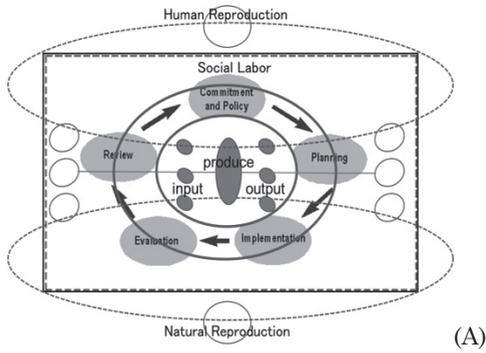


Figure 10 *The Continuous Improvement Cycle of EMS and Cyclical Intra-Product Specialisation*

Environmental Management System [EMS] refers to the management of an organisation's environmental programmes in a comprehensive, systematic, planned and documented manner. It includes the organisational structure, planning processes and the allocation of resources for developing, implementing and maintaining policy for environmental protection. The most commonly used framework for an EMS is the one developed by the International Organisation for Standardization (ISO) for the ISO 14001 standard. Established in 1996, this framework is the official international standard for an EMS. The five main stages of an EMS, as defined by the ISO 14001 standard, are described below : 1. Commitment and policy (Executive management commits to environmental improvement and establishes a company environmental policy. The policy is the foundation of the EMS.) 2. Planning (A company first identifies environmental aspects of its operations.) 3. Implementation (A company follows through with the action plan using the necessary resources (human, financial, etc.) 4. Evaluation (A company monitors its operations to evaluate whether targets are being met. If not, the company takes corrective action.) 5. Review (Executive management reviews the results of the evaluation to see if the EMS is working. Management determines whether the original environmental policy is consistent with company values.) (See Figure 8, A)

According to the progress of EMS, the formation of the recycling division of labour begins in the company. Alongside the process of production, a new division of labour which includes 'green procurement' and 'the offer of eco products' (Green Purchasing Network [GPN], for example), 'clean production' (for example, improvement of the production process), 'recycling' (for example, 'zero emission', 'appropriate disposal/appropriate treatment' and 'collection of the used product') are linked to division of labour in the existing company.

In the division of labour of the management processes, the functional devices such as ‘an environmental management section’, ‘environmental accounting’, ‘environmental information disclosure’ (environmental reporting), ‘environmental education’, ‘the development of the environmental technology’ are organised and founded. (see Figure 8, B)

This is the new division in microeconomic organisations or a new character in private capital. Of course, the aspect most relevant to this paper is the emerging structure of the new division that is also made up of P, C and D. C is the consumption part of production, the normal production and operation activities of the last stages of production. D is eco-production and eco-management that is analogous to the character of decomposer (see Figure 8, C).

Data about the number of world ISO14001 certifications are important to get a handle on the introduction of EMS into companies and the expansion of the recycling division of labour. From Table 1, it is clear that there has been remarkable progress in the largest economies, particularly in the northeast Asian countries: China, Japan, and Korea (see Table 1)¹⁶.

16 <http://www.iso.org/iso/iso-survey>

Austria AUT, Australia AUS, China CHN, Chinese Taipei TWN, Czech Republic CZE, Denmark DNK, France FRA, Germany DEU, India IND, Ireland IRL, Italy ITA, Japan JPN, Netherlands NLD, Norway NOR, Republic of Korea KOR, Romania ROU, Spain ESP, Sweden SWE, Switzerland CHE, Thailand THA, United Kingdom GBR, United States USA

Table 1 *Top 10 countries and World for ISO14001 Certificates 1995–2016*

N	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	
1	CHN	CHN	CHN	CHN	CHN	CHN	CHN	CHN	CHN	CHN	JPN	JPN	JPN	JPN	JPN	JPN	JPN	JPN	JPN	JPN	JPN	GBR	NLD
	137230	114803	117758	104735	91573	81993	69784	55316	39195	30489	22593	23466	19584	13416	10620	8123	5556	3015	1542	713	322	74	
2	JPN	JPN	ITA	ITA	JPN	JPN	JPN	JPN	JPN	JPN	CHN	CHN	CHN	GBR	DEU	DEU	GBR	GBR	GBR	GBR	JPN	GBR	GBR
	27372	26069	27178	24662	27774	30397	34852	39556	35573	27955	18842	12683	8862	5460	3700	3380	2534	1492	921	644	198	61	
3	ITA	ITA	JPN	JPN	ITA	ITA	ESP	ESP	ESP	ESP	ESP	ESP	ESP	CHN	ESP	GBR	SWE	DEU	DEU	DEU	DEU	DEU	DEU
	26655	22350	23753	23723	19615	17418	18347	16527	16443	13852	11125	8620	6473	5064	3228	2722	1370	962	651	352	166	35	
4	GBR	GBR	GBR	GBR	ESP	ITA	GBR	ESP	GBR	SWE	DEU	DEU	CHE	DNK	NLD	DNK	DNK						
	16761	17824	16685	16879	19470	16341	17064	14542	12922	12057	9825	7080	6253	4860	2917	2070	1260	851	360	270	119	21	
5	ESP	ESP	ESP	ESP	GBR	ITA	DEU	CHN	ESP	AUS	AUS	AUS	AUS	NLD	DNK	KOR							
	13717	13310	13869	16051	15883	15231	14346	10912	9455	7323	6070	6055	4785	4144	2803	2064	1049	708	352	263	96	19	
6	DEU	ROU	ROU	ROU	KOR	USA	USA	USA	SWE	USA	USA	USA	NLD	SWE	THA	AUT	AUT						
	9444	10581	9302	8744	11824	10925	9681	7843	7133	6392	5893	5061	4759	3553	2730	1645	1042	636	341	194	58	11	
7	IND	DEU	FRA	DEU	ROU	ROU	ROU	ROU	DEU	USA	USA	KOR	DEU	ITA	USA	AUS	NLD	ESP	DNK	TWN	KOR	FRA	FRA
	7725	8224	8906	7983	8524	9557	7418	6863	5709	5462	5585	4955	4320	3066	2620	1370	784	573	314	183	57	10	
8	FRA	FRA	DEU	FRA	FRA	FRA	CZE	DEU	USA	DEU	DEU	DEU	SWE	FRA	ITA	ITA	FRA	CHE	SWE	KOR	AUT	JPN	JPN
	6695	6847	7708	7940	7094	7771	6629	5865	4974	4877	5415	4440	3478	2344	2153	1295	710	543	304	174	56	4	
9	ROU	IND	USA	USA	DEU	DEU	DEU	USA	SWE	SWE	SWE	SWE	KOR	SWE	AUS	FRA	CHE	NLD	FRA	CHE	AUS	IRL	IRL
	6075	6782	6586	6071	7015	6253	6001	5225	4478	3800	3759	3682	2609	2330	1485	1092	690	470	295	170	53	3	
10	USA	USA	IND	IND	USA	USA	FRA	CZE	ROU	FRA	FRA	FRA	FRA	KOR	FRA	CHN	ESP	FRA	USA	USA	TWN	NOR	NOR
	5582	6067	6446	5872	5699	4957	5251	4684	3884	3476	3047	3289	2506	1495	1467	1085	600	462	291	151	42	3	
	KOR5009	KOR5436	KOR50540	KOR4719											KOR1065	KOR880	KOR544	KOR309	KOR263	CHN22	CHN9	CHN0	
T	319496	346147	324148	301647	284654	267457	251548	223149	188815	154572	128211	111162	89937	64986	49440	36464	22897	14106	7887	4433	1491	257	

4.3. Cyclical Fragmentation in General

The expansion of the company's internal recycling division of labour is formed through a 'small recycling society' of company level agents following various practices such as 'a zero-emissions in the company', 'regional alliances', and 'industrial cooperation'. In these processes, recycling fragmentations are functional. The formation of 'the recycling fragmentation' is the greening of 'pattern 0, 1, 2, 3' (pattern i) as shown above, or the blocking the recycling division of labour through the introduction of EMS as the catalyst for change. This paper pays attention to the environmental side of waste disposal treatment and recycling and arranges the initial and development patterns of 'recycling fragmentation'.

The basic pattern is an intra-company self-contained system = G (pattern 0) + B (recycling) where all duties of the recycling are fulfilled by their corresponding blocks, B (recycling) in management and production processes in the company by employing a 'recycling station', while 'pattern 0' is greened, G (pattern 0). For example, a company's zero-emission schedule can be pushed forward with this pattern as was the idea in Japan during the 1990s.

Of course, we can classify the systems of the waste disposal treatment and recycling that a company arranges for itself in the categories of a separate-administration type, a supplier-trust type, a doorway-cooperation type besides the company administration type. In other words, the development type of a specific company level can be categorised as: ① G (pattern 0) + Pattern 1 (recycling), ② G (pattern 0) + Pattern 2 (recycling), and ③ G (pattern 0) + Pattern 3 (recycling).

At the company level within the same industry, the development type mentioned above becomes ① G (Pattern 1) + Pattern 1 (recycling), ② G (Pattern 2) + Pattern 2 (recycling), and ③ G (Pattern 3) + Pattern 3 (recycling).

For example, a recycling system of ‘Group A’ and ‘Group B’ of the household appliance industry of Japan thinks that it is with a masterpiece of d ① and ② each. As a fine example of ③, the input-output relations between the companies in the Kawasaki Ecotown and the Kitakyusyu Ecotown are tractable.

This is the case where the ‘cyclical division of labour in industry’ supports the ‘cyclical division of labour in the product’. The former is progress in the industry caused by progress in the latter. In addition, fragmentation in the latter is concomitant with agglomeration in the former, or industrial clustering. In East Asia, the development of EIPs (eco-industry parks) and eco-owns are functioning examples of this interaction, which can be called cyclical agglomeration.

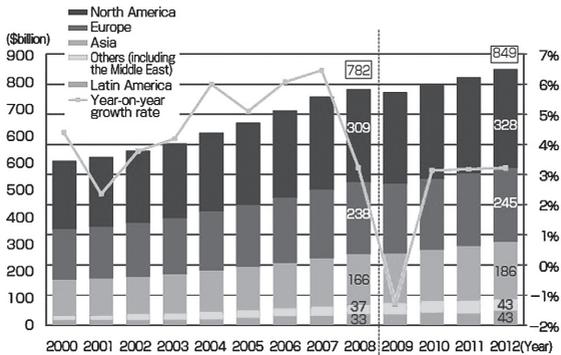
4.2. The formation of ‘zero industry’

In order to fulfil ‘desires’ inherited from DNA (see Section 3), in other words, to extend eco-consumption, the protection of the natural environment and EMS, the devices that have the purpose of modifying outcomes must be installed in the three reproductive processes elaborated above: human, economic and natural. For the establishment of these devices, one new industry group is sought. Distinctive from existing industry groups, this is ‘zero industry’.

In theoretical analyses, zero industry is a collection of industry activities that are performed in order to carry out the establishment and renewal of the mechanisms that maintain and reinforce the equilibrium relationships between humanity, economy and nature. This is the narrow sense of the concept. In a wider sense, zero industry is a set of industrial activities that can be added to the subsequent industrial activities that comprise it in the narrow sense. It is the activity of this wider sense of zero

billion in 1992, \$280 billion in 1997, \$650 billion in 2000, and \$336 billion in 2000 (see the lower-right curve in Figure 11 (b)).

By way of estimating the global market for the environmental industry, for example, the ‘Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon Society’ (compiled by the U.N. Environment Program [UNEP], the International Labour Organisation [ILO], and other institutions in 2008, hereinafter referred to as the ‘Green Jobs report’) expects the environmental industry’s global market size to double from an estimated \$1.37 trillion in 2006 to \$2.74 trillion by 2020 (see the upper-right curve in Figure 11(b)). Expectations are also rising for job creation in the environmental industry. The Green Jobs report estimates that green jobs in the renewable energy sector around the world, at about 2.33 million in total in 2006, will likely grow by 2030 to 2.1 million in wind power generation alone, 6.3 million in photovoltaic power generation, and 12 million in biomass power generation, for a combined total of at least 20 million.



Note 1: Figures for 2009 are estimates.

2: Figures for 2010 onward are projections.

Source: Prepared by Ministry of the Environment based on data provided by Environmental Business International Inc. (EBI)

(a)¹⁸

18 <http://www.env.go.jp/en/wpaper/2010/index.html>

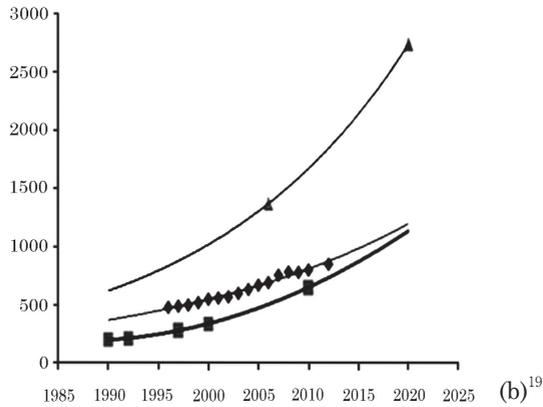


Figure 12 *Global Environmental Market Size*

According to estimates from Environmental Business International, the global environmental industry grew at an annual rate of a little over 4% between 2000 and 2008, though the coverage of the environmental industry and classifications are different from those of the Green Jobs Report. While the market is estimated to have posted negative growth in 2009 following the global economic crisis, it is reported to have resumed its growth and has continued to grow by a little over 3% in and since 2010. By region, the Asian market is estimated to have expanded by the largest margin between 2008 and 2012, growing by about \$20 billion during this period (Figure 11(a) left, and Figure 11(b), mid-right curve). Despite the embattled state of the global economy and resulting lack of political enthusiasm for tackling environmental and climate change issues, the \$866 billion global environmental market managed a 4% growth rate in 2011, fractionally ahead of the global GDP growth of 3.9% and up from the 1% decline

19 Data is from <http://www.env.go.jp/en/wpaper/2012/index.html>

recorded worldwide in 2009, according to Environmental Business Journal's (EBJ) 2012 bi-annual edition on the global environmental industry.

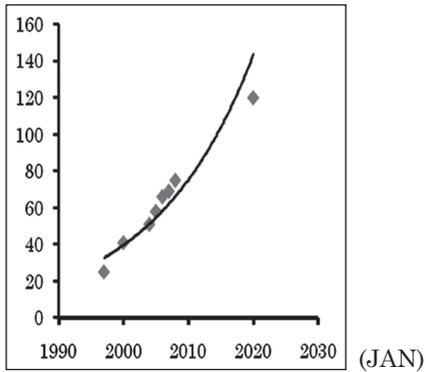
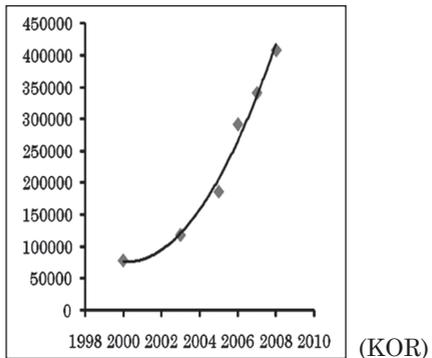
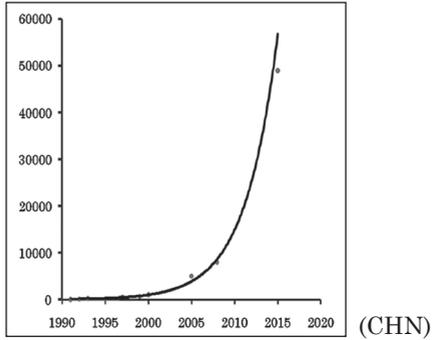


Figure 13 *Global Environmental Market Size*

The United States, Western Europe and Japan remain, by a substantial margin, the three largest environmental markets in EBJ's 11-region revenues analysis and are also the most mature. By contrast, growth of the global environmental industry in 2011 was led by Africa, which grew by 10%, followed by the Middle East and the rest of Asia, both up 9%. In terms of the 14 global environmental business segments tracked by EBI, the largest was Solid Waste Management at \$140.9 billion, followed by Water Utilities and Water Treatment works. However, Clean Energy Systems & Power ranks as the fourth largest segment in 2011, demonstrating a robust growth rate of 11%—significantly higher than the traditional infrastructure segments. Only Resource Recovery grew faster, up 13% in 2011. 'Renewable energy, water reuse, recycling, green building, energy efficiency, and other areas under the resource recovery and clean energy umbrellas are all growing at rates higher than the total economy in most nations,' as noted by Stubbs. 'For example, more than 10% of Germany's electricity production now comes from renewable sources, and a few other countries are in the 2–5% range.'

As shown in the chart below, China (LCU: 100 million RMB), Japan (LCU: 1 trillion yen) and South Korea (LCU: 100 million won), have seen a remarkable expansion in the industry (see Figure 12)²⁰.

Figure 13²¹ shows the total worldwide sales and the shares of these

20 Ministry of the Environment Government of Japan *Annual Report on the Environment, the Sound Material-Cycle Society and the Biodiversity in Japan*.

LONG Shixiang, 'On the Cyclical Division of Labour and its Fractal Structure' *14th Asia Pacific Industrial Engineering and Management Systems Conference (APIEMS 2013)* (Cebu Philippines), 4 Dec 2013.

21 See *LOW CARBON ENVIRONMENTAL GOODS AND SERVICES (LCEGS): Report for 2010/11*, BIS, May 2012.

<https://www.gov.uk/government/publications/low-carbon-and-environmental-goods-and-services-2010-11-report>

three East Asian countries. By UNSEEN ABBREVIATEION BANK OF INTERNATIONAL SETTLEMENTS? BIS, total LCEGS sales in 2010–11 were £3.3 trillion and were estimated at £1.6 trillion (48% of the total global environmental industry), compared with £1 trillion for renewable energy (31%) and £0.7 trillion (21%) for environmental. The breakdown of global sales is shown in more detail in Figure 13, where the top 30 countries have been ranked, showing columns for total sales value (in £ million), country sales as a percentage of the global total, and country ranking. As can be seen in Figure 13, the US accounts for 19.5% of the global total, followed by China (13.1%) and Japan (6.2%). South Korea is ranked fourteenth with a market share of 1.8% FIGURE 13 VALUE INCORRECT %.

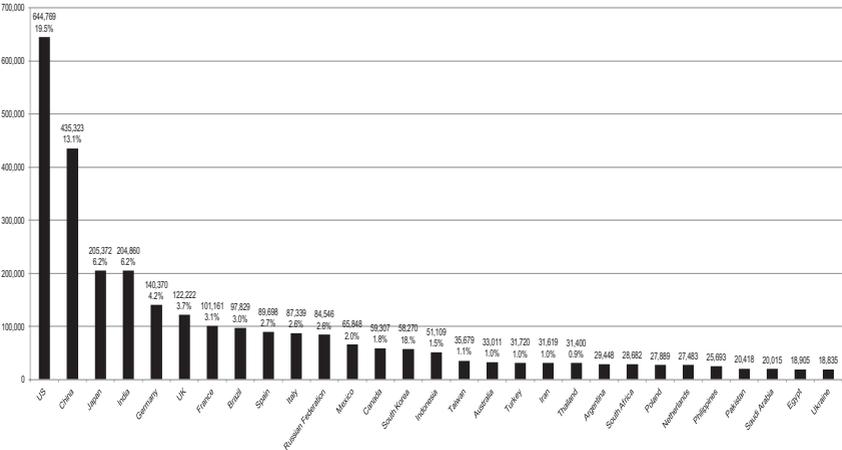


Figure 14 Global Value of LCEGS in £m by Top 30 Countries for 2010–11

5.3. Zero industry and the equilibrium cyclical society

In the vicious circle society, zero industry holds at least the next two functions. The first function strengthens the self-adjustment capacity

through the actions of the green adjustment device in each of the reproduction processes. The second promotes the transfiguration of the reproduction processes towards a direction of shared equilibrium. The conversion of the industrial structure and the socio-economic system through the expansion of zero industry becomes a core process in the construction of the equilibrium cyclical society.

4.4. Zero Industry, input-output table and fractal relations of the equilibrium cyclical society

Leading industry is converted in appearance and form to that of 'zero industry' and the essence of the industrial structure transfigures accordingly. The following physical industries have been excluded from the input-output approach until now. They are physical industries with reproduction processes that exist in the space between human and natural reproduction processes. These physical industries correspond to the related links between the economic and natural reproduction processes. However, excluding the physical industries from the input-output approach cannot be achieved through the formation of the environment industries alone, and we cannot ignore the influence that existing physical industries have on the formation of environmental industries. Therefore, it is worthwhile to build an input-output table, which zero industry can be factored into.

In economic reproduction processes, zero industry plays the role of the decomposer. In human reproduction processes, eco-consumption plays the same role. The expansion of both strengthens the autolytic power of human society and the power of self-recovery in natural reproduction processes. Then the structure of the vicious circle switches from a fractal structure to a cyclical equilibrium.

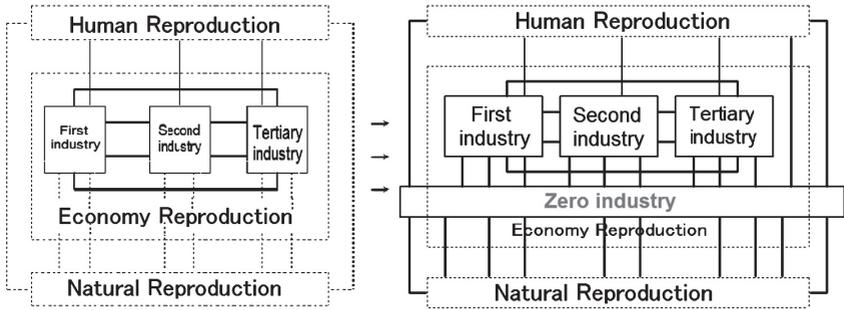


Figure 1 *Zero Industry, Input-Output Table*

5. Conclusion

By the considerations mentioned above, we understand the following. The number and size of EMS and the environmental industry are constantly expanding. The cyclical division of labour thereby unfolds surely. A harmonious circulation society has begun to build. Society is working to repair DNA disturbed, and the removal of the disturbance element of DNA is starting. It is switch of the social system. This rearranging creates a future problem.

This rearranging creates the future problems that are the objects we continue to study. Firstly, the empirical analysis of new developments of the cyclical division of labour's fractal structures will be continued. Secondly, a mathematics model on the process forming and the process developing of this fractal structure is researched. Thirdly a factor analysis of the international dimension is given. Fourthly, the value structures in the recycling international division of labour are discussed. Here, the issues of profit-sharing and cost-sharing are discussed, and economic externalities are introduced into the analysis.

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提出年月日：2018年5月16日