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BOOK REVIEW

A review on Yoshinori Shiozawa, Masashi Morioka, and Kazuhisa Taniguchi, Microfoundations of Evolutionary Economics, Springer, 2019

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Abstract
Shiozawa, Morioka, and Taniguchi's new book explores original theories of price and production to develop a new microfoundation for evolutionary economics. This review examines new contributions from this study, followed by some expected arguments from the readers. We may like to ask, for example, how we can understand the general fluctuation of prices (i.e., inflation and deflation) using the minimal price theorem (Chapters 1 and 2). Another important discussion may be the possibility that the fit of human behaviours in the stable condition will lead to a delay in various decision-making situations other than production (Chapters 3–5). The latter part of this review takes up two ideological implications of this study. One concerns the significance of developing a formal theory for evolutionary economics. Many were opposed to formal theory itself in the genealogy of heterodox economics, including evolutionary economics. There have also been numerous discussions on which side is correct. This review attempts to clarify that there is some ideological reason to be against formalistic approaches from the viewpoint of economic thought and that it is not necessary to decide which side is correct. The other is about how an economic system, which is built on bounded rationality, affects its bounded rationality itself through the circulation of economic activities. These thought experiments are inspired by the "micro–macro loop" method considered in this book, which is only a part of the wide-ranging implications that this study offers beyond the immediate theoretical discussion.

Keywords Evolutionary economics · Homo-economicus · Bounded rationality · Rationalism · Romanticism

JEL classification B (History of Economic Thought · Methodology · Heterodox Approaches)

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1 The aim of the book

Imagine you are walking along the street and happen to feel thirsty. You go to a convenience store to buy a bottle of water, and perhaps you can get it with no trouble. There seems to be nothing interesting in this scene that attracts our attention. However, if you are an economic professional, you ought to feel uneasy about this scene because you happened to feel thirsty without any previous awareness or notice. Nevertheless, there were a lot of water bottles whose buyers were not decided as if they had been waiting for you. This means that these commodities had been supplied before your demand appeared. How was that possible? This is the question that Shiozawa et al. (2019) who are sure to play a monumental role in the history of evolutionary economics, devoted their whole study to explore.

Why does this scene matter in neoclassical economics? If the price mechanism functions well, demand and supply must be equalized under the equilibrium price. The demand here comes from the ones who have already responded to the equilibrium price (at the equilibrium the supply is equal to that demand). Therefore, this supply does not allow for a surplus amount for cases where the demand that has not yet appeared. How, then, can you get a water bottle? Your demand was not exhibited when the equilibrium supply was decided.

In the ordinary market theory, your demand must be treated as excess demand. It will only be acknowledged after the price has risen due to the pressure of excess demand, and after firms increased their supply responding to that rising price, that you can relieve your thirst. Nevertheless, the authors of this book ask the question "have you ever experienced such an inconvenience?".

If the price mechanism functions well, your unexpected demand will not be satisfied. However, that is certainly not the case in our common experience, at least for people living in advanced economies. If the price mechanism does not function well, and the excess supply is left behind for some time, your accidental demand can indeed be satisfied. For instance, if we admit almost all markets have become oligopolies, and the myth of price mechanism is now out of date, it will not be so difficult to make an economic model that can satisfy your unexpected demand. However, the neoclassical view rejects the idea that this is a normal condition of the modern economy.

Some other neoclassical economists may say, aside from the pure theory that firms in the real world decide their production based on a kind of expected demand which factors in some unexpected demand. This is a far more realistic explanation than the excess supply story, and is also the course of discussion this research seeks to explore. However, if firms really behave as scholars assume, the market price is going to reach the level corresponding to the demand that includes the additional "unexpected" amounts. Moreover, it is surely unreasonable to suppose that the price rises before any extra demand has appeared.

Therefore, whichever of the two directions you choose, it seems difficult to represent our daily experiences. What is a standard theory that cannot explain standard common experiences? This book tries to present a new economic theory

which draws on our daily economic experiences, in order to ask and answer the simple but important question: "how can you get what you want, anytime and anywhere?".

The basic structure of the book is as follows. Chapter 1 investigates the presupposition of the standard price theory and offers an alternative supposition of the economic agent. The standard price theory can be considered the outcome of the presupposition of an agent, that is, Homo-economicus. To be free from the standard theory, we need to rebuild the new image of an economic agent by basing it primarily on our daily experiences. The criticism against the concept of homo-economicus leads us to criticize the neoclassical image of the firm that, in principle, does not distinguish between an individual producer and an organizational firm. The critical history of homo-economicus is summarized here, which is in a sense the history of heterodox economics, where we can find an origin of evolutionary economics as well. Chapter 1 fixes the historical and theoretical foundation of this book, introducing a new type of economic agent.

Chapter 2 presents an original new price theory. The price in this theory is no longer supposed to be a mere parameter which coordinates demand and supply. The new role of price is reformulated as a necessary condition for sustaining the reproduction system. Furthermore, this new price theory shows that the condition of demand plays no role in the making of prices.

If the price does not take the role of coordinating demand and supply, what elements do instead? It is the inventory, of course. Firms try to decide on production which includes consumers' unexpected demand to a certain degree. That is why you can satisfy your sudden demand without waiting for the price to rise. Nevertheless, if the planned production is unfortunately short of demand, and the demand is not satisfied even after the whole inventory is released, what will happen? In such a case, it only comes to an end when some customers cannot buy what they need, and they have to wait for the next delivery. There is no reason for the price to rise in this case. If firms intend to raise their prices because of the shortage of supply, they will lose their good reputation in the eyes of customers. Price coordination is no longer the choice that firms can take in the real situation. Based on that, this book offers an original new production theory which is true to the experimental presupposition from Chapters 3–6.

In a situation where demand exceeds the inventory, customers principally have to wait. However, some customers will try to get the good through a second-hand or an online market, where prices may not be based on production costs. This book seems to admit that the standard price theory can be applied to these situations, especially in Chapter 7, and it seems rather odd because this book has stressed the essential difference between the original price-production theory and the standard theory. However, their new price-production theory is created for commodity markets, that is the flow market, but the second-hand market is basically the stock market. The authors reasonably distinguish the price mechanisms in the flow market and the stock market. In that sense, they seem to follow the genealogy of the dichotomy of price theories which was founded by M. Kalecki. However, while the traditional price dichotomy is based on the difference of market structures, that is, whether the market is competitive or monopolistic, the dichotomy shown in this book is not based on

the market structure, but on the different dimensions of the market (in other words, whether the market is the flow market or the stock market). It can be said that the dichotomy in this book is more general than it used to be. The authors argue that the price mechanism in a stock market is their future subject, but Chapter 7 displays the scope of their book is not restricted to the production theory in the narrow sense.

2 Fiction versus reality

This book thoroughly investigates the principle of the "real" economy. "Real" here does not mean that an economic model should approximate the real economy as a result. The authors require that an economic model approximate the real economy in the presupposition. Since M. Freidman, economists have held the premise that economics does not require reality in the presupposition of an economic model. The purpose of economic models was considered to be the prediction of real economy trends beforehand. The presupposition of homo-economicus, or rational expectation, is simply considered a useful, albeit fictitious, methodological tool for building a logical model as if people were behaving like that. Therefore, even if we have got a lot of statistical data that is consistent with the economic model, it does not necessarily mean that homo-economicus exists in reality, though it seems doubtful that this premise is being held consciously today. We frequently hear scholars argue that the behavioral assumption of his or her model is proved to be the truth by ascertaining its statistical significance.

Such Freidman-like methodology may be justified as long as we consider economics a tool for analyzing economic data. However, it is worth remembering that a tool cannot lead us to the epistemology for economic society as a whole. Evolutionary economics has been pursuing such a general view, as oppose to the tendency to consider economics as just a tool or a measure.

The general equilibrium theory has functioned as such an epistemology in neoclassical economics since L. Walras. In the general equilibrium theory, price is the only parameter that makes the simultaneous equilibrium of demand and supply for all markets. In this context, people are thought to be able to pursue utility maximization without any obstacles. From this perception, Walras showed that there might be one possibility of social order as the general equilibrium, even if people were free from any social constraints in those days when they remained under the deep shade of France's feudal society.

Walras, however, showed only the equality of unknown numbers and equations. After him, as the general equilibrium theory became more sophisticated, more and more "rational elements" were added to the model, such as grasping his or her own utility levels accurately, equating the weighted marginal utilities, changing their consumption plans freely, and so on. In addition, the auctioneer, a calculator of the general equilibrium solution, is defined as having supra rationality that finds out the tiny disequilibrium of all the markets, and coordinates relative prices in the blink of an eye. As a result, we obtained an excellent mathematical theory, but were left with poor epistemology that cannot even answer a question as simple as "why are there things we need in the store even when we go there without notice?" To be free

from such epistemological backwardness, we have to release ourselves from such an understanding that the general equilibrium theory represents the real economy.

As a first step for the release, this book raised the simple and fatal question that neoclassical economics forgot to ask: whether the general equilibrium can really be solved if we admit such a vast amount of rationality. Yoshinori Shiozawa, one of the authors of this book, made it clear in his 1990 book, *Shijo no Chitsujogaku,* that if you count hundreds of items, the general equilibrium cannot be achieved even if you took all the time since the Big bang! Although the calculation ability of a computer has improved significantly since the book was published, the number of items around us has also increased a lot since then. The NP-hard problem will still be the fatal critic of the general equilibrium theory.

If the general equilibrium cannot be achieved, the prices we face every day cannot be called the general equilibrium price. If so, what mechanism determines prices? If we do not assume the general equilibrium system, what plays the role of coordinating the demand and supply? In other words, how can an economy sustain its stability without price coordination?

This book first examines the first question. Building up the brand-new agent supposition is the first thing to do in this exploration; the agent image has to recover its reality if we want economics to be a social epistemology. To make sure this happens, this book suspends the habit of economics, or the habit of thinking that is institutionalized by economics, and tries to imagine real-life scenes of a flesh and blood person with a free mind. In fact, we are not people who can instantly grasp all information, deduce the optimal behavior to maximize our benefit at the same time, and execute the action without any constraint or doubt. We only know what happened in the past to some degree, and have no idea what will happen in the future. Furthermore, we have no idea how to utilize these pieces of information, however much variety we have access to, to maximize our benefit. In addition, even if we get to know a better way to tackle this, we rarely throw ourselves into such a "calculous result." For instance, if someone advises you to go to America to become a lawyer and get much better opportunities for success than being employed in your current role in Japan, you cannot be so naïve as to hand in your resignation at your office the next morning. Have you displayed irrational behavior here? On the contrary, most people will say that you have made a wise decision. This is the normal way of behaving that ordinary people are likely to choose.

The real economy is the product of such behavior that uses common sense. That is why this study intends to make behavioral presuppositions of a flesh and blood person, and to draw on an economy that is the aggregate result of such behavior. Therefore, it is not the system that will keep the identical situation forever like the general equilibrium theory does. Even if economy or society apparently look the same, people might change their behavior a little every day. If such tiny changes keep piling up in a complex way, the economy itself might change from *inside,* even in a situation where the external conditions are kept stable. These ways of thinking are of evolutionary economics, which is always open to a possibility of an agent that displays ever-changing economic behavior.

The microfoundation of evolutionary economics needs those images of economic agents and various ways of behavior those agents naturally choose. The image of

the human character like this is the so-called "bounded rationality," a concept that is also adopted in the basis of this book. In neoclassical economics, the agents under bounded rationality are described as beings who try to maximize their benefit under the constraint of bounded rationality. This book takes a different line, where agents are supposed to be restricted in their ability to gather and utilize the information. They do gather information, but they do not gather all the possible information, meaning they will inevitably gather biased information. If they intend to get some vision for the future, their range and scope of imagination and interest will be naturally restricted. People in the real world are interested in just the myopic range of time and space. If they need to do something, they usually will not decide to take one step forward outside of their known area. This book supposes these limits of capability; in other words, bounded rationality, myopic sight, and limited range of execution are the basic propensities of a real person's conduct.

This type of person will not change their actions in every different situation. Their rule of behavior is basically a repeat of this conduct, because it is impossible for them to change their attitudes so drastically day by day on account of their information, view, and ability being restricted. Or, it is possible to say that people can decide how to live today under bounded rationality because they have some confidence in their minds that today will be almost the same as yesterday. It is not that people do not foresee changes in the future. We all acknowledge that the future does not unfold as a straight line stemming from the past; however, knowing that, we cannot begin to take a completely different behavior today from what we did yesterday, not knowing exactly when and in what ways we can change our behavior. That is why most of us tend to repeat almost the same behavior as yesterday. This is the basic presupposition of human behavior adopted in this book, which applies not only to consumers but also to producers or firms. After establishing such a theoretical foundation, the authors take a step forward to build a brand-new theory of price and production based on this microfoundation.

3 A new price theory of evolutionary economics

If the prices are not determined as the general equilibrium prices, they have to be determined by each firm in each market. There is no guarantee that those prices can equalize demand and supply as it is impossible for firms to know what prices can balance demand and supply before they set prices. Firms will be satisfied if the prices recover the costs of production and produce a certain amount of profit.

According to this book, the price setting behavior is described as follows. If a production technique (or technical system) h can produce good j, we express it as $j = g(h)$. The sign g means a map from the set of production techniques to the set of production goods. Let $u(h)$ be the labor input coefficients, which mean the unit labor inputs to produce good j, and $a(h)$ is the material input coefficient. It is natural to think that there is more than one kind of material input to produce a single good, so $a(h)$ should be considered a vector. When the wage rate is w, and the price vector of goods is p, we can denote the prime cost of production, which is the sum of labor cost and material cost, as $u(h)w + < a(h), p >$. If the mark up

ratio which firms demand under the production technique h is $m(h)$, the price of good j, that is $p_{j,}$ is given:

$$p_j = (1 + m(h))\{u(h)w + \langle a(h), p\rangle\}$$

This book calls this equation value equation.

Here, we should notice that p_j is also included in the price vector p. In this production system, each output produced as a commodity is input into the system, which is literally the *production of commodities by means of commodities*. Therefore, the production technique h, or the technical set T that includes h, has to be able to produce at least some surplus products. This book extends this a little further; the technical set T is supposed to be able to produce not only surplus goods, but also the surplus value including the mark-up. When this condition is satisfied, the set T is called productive in the extended sense. With these definitions, this book deduces the most important theorem:

Minimal price theorem I
Let T be the set of production techniques. When the set T is productive in the extended sense, there is a positive value vector $v = (w, p_1,\ldots,p_N)$ with a given positive wage rate w and a subset S of T, which satisfy the following conditions:

1. For any given product, S includes at least one production technique that produces it.
2. Any production techniques in S satisfy the value equation.
3. All other production techniques in T have the hull cost, which is greater than or equal to the product price.

Following this theorem, the value equation is generalized as given below, which is a matrix formula including all the goods.

$$(I + M)\{wu + Ap\} = p$$

The matrix A is $N \times N$ square matrix because there are N-kinds of input goods and N-kinds of output goods. I is the unit matrix and M is a diagonal matrix of dimension N respectively. The wage rate w is supposed to be homogeneous among firms given that labor itself is homogeneous in a country. The next equation can be deduced from the above formula.

$$p = w\{I - (I + M)A\}^{-1}(I + M)u$$

If we think A and u include the mark-up ratio, we will have the simpler form:

$$p = w\{I - A\}^{-1}u$$

The minimal price theorem can be summarized as follows: the prices are determined by technical systems which determine A and u, with a given w and M.

We should note that the demand elements do not play a role in this formula. The price will not go down if the demand decreases. Any fluctuation in demand will be absorbed into quantity adjustment (i.e., inventory adjustment). If the price happens to change, it is only when some technical change occurs, which can illustrate why prices do not respond to the daily fluctuations of demand.

As confirmed at the beginning, the aim of this book is to find an economic theory which draws on real economic phenomena. At the same time, it avoids an attitude that as if we do not need more formal explanation than the strict literal description of the real economy, as is often seen in heterodox economics. Its style of investigation is just what evolutionary economics has been needing, and heterodox economics has been lacking.

This book extends this basic model to issues such as co-production, multiproduct firms and industries, fixed capital goods, nonhomogeneous labor, multiple primary factors, and international trade. As for international trade, however, although the minimal price theorem needs some adjustments, this is outside the scope of this research.

That being said, some questions may be raised about the formula. For example, someone will ask whether there are any new differences from conventional mark-up pricing theories since Hall-Hitch model. Although there are no parameters to represent the demand is in this formula, it seems possible that firms can reduce/raise the mark-up ratio for the demand to decrease/increase. If this is the case, then it is unacceptable to say that demand never influences price.

What induces these questions lies in the presupposition that the mark-up ratio is given. For this reason, the mark-up ratio has been understood as the parameter that firms can freely raise or reduce according to the business situation. Therefore, the mark-up theory has been valued lower than the marginal principle because the former permits more arbitrary handling than the latter. Because this book also gives the mark-up ratio as data, its authors will be asked the same question.

However, the formula in this book has an important difference from the mark-up theories so far. What holds the key role is the minimal price theorem. Almost all the previous mark-up theories have treated firms individually. The prime cost is just a given production cost and the firm merely adds the mark-up to that cost. Therefore, it seems that firms can set the mark-up at their will and freely raise or reduce the mark-up ratio according to demand.

In contrast, the price in the prime cost in this new formula already includes the mark-up. Changing the mark-up ratio may change not only the price of a product, but also, at the same time, the prime cost itself. Here, the prime cost is not just a given cost, but a cost determined endogenously in the production system. This is a big difference from conventional formulas. Of course, if it is just one firm's price change, the influence may be negligible. However, if it is an overall change in prices by the change of the whole business condition, it will change not only the final goods prices but also the price vectors (perhaps unevenly), which constitute the prime costs. The minimal price theorem claims that there must be some production technique which is consistent with the new prices. If such a production technique has not been included in the technical subset S in advance, firms

cannot find the appropriate price for their business. It will be difficult for them to continue their business in that situation.

The minimal price theorem therefore seems to suggest that such a response from firms is also possible, and that changing the mark-up ratio is not so free and easy as previously thought. Firms cannot coordinate prices so flexibly and willingly to short-term fluctuations. Consequently, we can say that the price is determined technically.

There may be two further challenges for the theory. One is about its verifiability; that is, whether the existence of the technical set T or the subset S can be positively proved. It is no help saying that the price system cannot exist if the technical set does not exist. This theory requires the reality of the presupposition, not of the result, so this theory needs to prove its verifiability in a different way to the logical positivism of the neoclassical view.

The other challenge is how to explain inflation and deflation using this theory. At first glance, it seems to be easy to explain both as a process of changing input prices even under the fixed mark-up ratio. However, as mentioned, such price changing must be impossible without another technical set that can sustain the value equation, unless all the prices are changing proportionally. Then, if such a convenient set does not exist, will inflation and deflation be arrested by its technical limit? If this theory claims that prices are not influenced by increases or decreases in demand, it will have to show how the general price fluctuations can occur, by clarifying the role of production techniques.

In any case, the minimal price theorem reflects the obvious facts, but at the same time, it tries to explain why and how it is difficult to alter prices to fit the level of demand from the technical side. We must acknowledge its novelty in the history of economics.

4 The stability of the new inventory adjustment model

The latter half of this book focuses on the inventory adjust model on the basis that price does not respond to the conditions of demand.

The key elements of the model are as follows; (1) The prices of goods are stable for some time, if not forever. Short-term fluctuations in price are basically absorbed by inventory, and setting new prices needs to be consistent with some other technical systems. (2) The sales of products are determined by the smaller side of demand or supply. When the supply exceeds demand, inventory increases, whereas when the supply is short of the demand, some customers who cannot buy the product come into existence. (3) The supply in each period equals the sum of the final product inventory and newly produced products. The firm can only know the actual demand for its product after the term begins. (4) Finally, most firms presume the conditions of demand and supply remain unchanged. It is not the inertia of firms, but that firms do not have enough information to decide on any changes of production.

It is important to note that the supply is not the same concept as the product in this model. The supply is the amount of production plus the inventory, and the former is the quantity to be produced in each period, a certain part of which will become inventory for the next period. Therefore, the prediction of *sales* during a

period is very important in order to maintain the appropriate inventory level for the next period. If the predicted sales are larger, the production of this period has to be larger, and vice versa. A product has to include intermediate goods, and the production of intermediate goods can be formalized in the same way as the final goods; the volume of intermediate goods relies on the volume of final goods.

From the above observations, this book constructs a comprehensive matrix model including the production of final and intermediate goods. The model is shown below.

$$z(t) = z(t-1) + x(t-1) - s(t-1)$$

$$v(t) = v(t-1) + m(t-1) - x(t)A$$

$$x(t) = s^e(t)(I + K) - z(t)$$

$$m(t) = s^e(t)(I + L)A - v(t)$$

Here, $z(t)$ is the product inventory vector at the end of period t, $x(t)$ is the production vector of the current period t, and $s(t)$ is the actual sale vector of period t. (Each sales amount in the vector is determined by the lowest amount, be it demand or supply, in period t). $s^e(t)$ is the forecasted demand vector through period t. $v(t)$ is the raw material inventory vector in period t. $m(t)$ is the raw material product vector in period t ($x(t)$ and $m(t)$ are ordered at the beginning of period t). A is an input matrix. K and L are inventory coefficient vectors for final goods and raw materials, which determine inventories for the next period based on the sales in this period. Every good is used as a final good and as an intermediate good; Therefore, if the demand does not exceed the supply, the sales of each good is equal to the sum of the final demand and the intermediate demand. So, $s(t)$ is redefined as $s(t) = m(t) + d$ (d is the final demand).

By integrating all of the equations above, we obtain the following simple equation:

$$s(t) = \Delta s^e(t)(2I + K + L)A + s(t-1)A + d$$

The dynamic character of this equation clearly depends on the input matrix A and the forecasted sale $s^e(t)$. Neoclassical economists may say that this model could be stable by introducing perfect foresight, and therefore, they could follow the typical narrative that the instability of the economy results from some kind of *obstacle* that disturbs perfect foresight.

However, this book takes an unexpected turn: it supposes that the forecasted sale does not change ($\Delta s^e(t) = 0$), and that perfect foresight is possible $s(t) = s^e(t)$ in order to stand the same ground as standard economics. Based on this supposition, this book applies Frobenius theorem to test the convergence property of this model. As a result, this book makes clear that Frobenius roots calculated from the real input–output table do not satisfy the stability condition in many cases. What is meant here is that the foundation of economic instability originates from

the production *structure* itself, not from an economic *behavior* such as imperfect foresight, irrational behavior, and so on.

The sound of the word "structure" gives us the image of something hard. So, we are apt to imagine a "structure" as something stable in its essence. Therefore, if there is something to destroy that stability, it must be something plastic and capricious, typically it is human "behavior." This model tells us that such an understanding is no more than a preoccupation. We often cannot help holding a false image of the economy by accepting the linguistic image of the word as self-evident.

This book further investigates how to forecast the real sales and the sales' influence on the dynamic propensity of this model. It is not too much to say that this section is the highlight of this book. There will be two options for forecasting the actual sales in real and experimental situations. One is the simple moving average and the other is the geometric moving average of past demands. In both cases, the agents are not supposed to alter the forecasted sales by only one experience (for example, the current sale has been very good). It is neither an inertia nor an unreasonable physiological impulse that behavioral economics asserts, but instead is a result of the practical rationality of people which has been cultivated through a variety of experiences in the seamless flow of time.

This book estimates the dynamic character of each method using a computer simulation. As a result, it concludes that the model becomes more stable when a moving average is taken for longer periods or a more even distribution of weight is put on every period; however, inevitably, it partly depends on the structure of input matrix. We believe those results of computer simulations will be breakthrough achievements in the history of evolutionary economics; these results also match our intuitions; it seems very likely that the system, where the forecasted sale is a core element, will be stable if the forecasted sales are stable in the face of short-term fluctuations. However, if you underestimate the contribution of this book on the basis that the result does not exceed your intuitions, you will be making a big mistake. What is important here is that it certified our intuitions through a formal method. No matter how we assert that standard economics is against our intuitions, we cannot be very persuasive without following formal procedures. It might be said that we have finally got a theoretical foundation for evolutionary economics, or for heterodox economics.

This book extends this basic model to issues including work-in-process inventory, partial adjustment, a multi-firm model, and adjustment accompanied by stockout, rationing, and bottleneck. There seems to be one reservation of this theory; It is basically a theory for goods production of firms and not yet applicable to other general situations. It could be applied to a lot of real situations other than a firm's production activity because this model satisfies the experimental validities in many cases. However, the behavioral rule of this model, that is, so to speak, the "Let us wait and see for a while" principle, performs the function of stabilizing the economy, while leading to a conservatism in situational changes. Because of this, there might be some delay in dealing with real problems, which may appear as a delay in firms' innovations. However, when almost all firms do this in the same way, it is not likely that the delay will bring a fatal damage to some particular firm.

The real difficulty will arise when such a behavioral rule works for an economic or social policy. For example, the Japanese policy authorities maintained this attitude of "Let us wait and see for a while," during Japan's poverty problem that set in in the early 2000s, saying it was dangerous to cope with a real problem prior to deliberation. As a result, there were irremediable delays in their policy response. It was not until the situation became irredeemably serious that policy aimed at reducing inequality was implemented. In some cases such as this, "Let us wait and see for a while" principle is obviously not appropriate.

We do not need to worry about those problems as long as this book restricts its theme to the production of commodities. However, if you once exclude the neoclassical way of thinking, including the normative standard of judging the economy from outside (such as the social surplus or Pareto optimum), or if you do not judge whether the current status is good or bad depending on whether it is approaching the general equilibrium or not, by what standard will you judge the normative status of economy? The "Let us wait and see for a while" principle has a strong positive validity, but if you put it into the normative standard, it could be very inappropriate. Therefore, evolutionary economics cannot use the positive theory in place of the normative theory, which those subscribed to the neoclassical view do. In other words, the model in this book suggests that evolutionary economics now needs its own original normative standard to overcome the narrowness of its applicability.

5 Significance of developing the "theory" for evolutionary economics

From this section on, we would like to consider some issues in the future of evolutionary economics, going beyond the scope of the study's direct focus.

The first topic is what the significance to develop such a formal theory is for evolutionary economics. As in the title of the book, it explores the microfoundations of evolutionary economics in depth, from price setting to production decisions including inventory levels, by employing the use of a highly sophisticated model. Furthermore, this book also makes clear that repeating these economic activities leads to a kind of stability through computer simulations. This book does not yet investigate the evolutionary endogenous dynamic model itself, but by introducing the concept of technical changes into price decisions, as well as the feedback of macro-conditions to production changes, it will not be so difficult to develop an endogenous model based on the model presented in this book. Perhaps the next target of research for the authors ought to be set on such a dynamic model.

There may be some opponents for whom their approach is a kind of compromise with neoclassicals because it is going to build upon, and depend upon, such a mechanical model. That is taken to be undesirable because evolutionary economics is supposed to reconsider the economy as a more biological and organic entity as opposed to a mechanical one. Its framework should be based on the view of real human beings constituting an evolutionary economy as a living and organic entity. Further, the image of such natural elements growing into one word is nothing but "generating." That cannot be, nor should be, described as the repeating of patterned

behaviors. If we were to describe a generative image using mathematical models, we will be using an extraordinarily high level and complex model, that economics has not yet reached. Evolutionary economics must also wait for a while longer and refrain from casually compromising to build a defective mechanical model.

Discourse like this was commonly seen in the early days of evolutionary economics. It is not certain that such an opinion is still vital today, but considering the statement "evolutionary economics lacked theoretical foundations: no theory of value, no theory of behavior, no proper tool of analysis, and no proof of how an economy works" (SMT,p.1), it appears to have survived up until recently.

Imaging an economy as a generative system is not wrong at all. Evolutionary economists more or less share the image of the generative economy that gave the original foundation for creating this new approach to economics. Therefore, it can be said that evolutionary economics used to have nothing to do with a biological theory of evolution at its start. The word "evolutionary economics" has its origin in T. Veblen, but what he wanted to express was the generative image itself, and he did not necessarily follow the theory of evolution by C. Darwin or J. B. Lamarck faithfully. Thus, I believe it is about time evolutionary economics abandoned this confusing name.

It should also be noted that the image of a generative system expresses a certain nature of a system, but it is not necessary to compare it to a living organism; there is no reason why we should not express it in some mathematical form. The effectiveness of the mathematical approach, as in this book, can be justified from this very fact. However, let us take one step further. What kind of image do we unconsciously share when we talk about evolutionary economics?

Evolutionary economists seem to share some characteristic methodologies in addition to the generative image of economy. Firstly, for them, recovering a sense of reality is the most important factor. Unlike Friedman, they do not emphasize an instrumental effectiveness. In particular, economic theories need to match our sense of reality about the economy. Recovering the reality of economic agents, that is presuppositions of bounded rationality, short-sighted views, and so on, can be added here. Secondly, what they should seek is not a normative theory nor a normative standard of judgement, but a positive theory which can describe the realistic economy itself. This contrasts the neoclassical methodology which tends to employ its positive theory as a normative standard of judgement. Thirdly, even though this is not shared by all evolutionary economists, they think every economic situation or every economic behavior has a singular value. Therefore, they are critical of the attitudes that try to reduce them to a difference of parameter of a principle. This means they give priority to "quality," not "quantity," and this is another sharp contrast to neoclassicals' scientific approach which tends to reduce everything to numerical bias.

Finally, they also share a generative image of economy. It might illustrate their unique concept of time, which is completely different from the neoclassicals' linear concept of time. Neoclassical economists (classical economists are the same in this aspect) implicitly suppose that there is an "essential form" of economy before all our daily experiences. That essential form is supposed to emerge itself in the long-term equilibrium, or in the long-term trend which is not disturbed by

short-term disturbances. Time in economics is thought to be a process of going straight from the surface appearance of an economy to the long-term essential form (hence imaged as "linearly" or "straight").

In contrast, evolutionary economics do not like to have such an image that economy goes in a linear way to some predetermined essential status of economy as if it is fate. For an economy to continue to "evolve," there must not be the predetermined terminal form. When it seems to reach an end, it should turn itself to a new origin in order to create the next stage of the economy. The current economy was born from the previous one in the same way that the present economy will bear the next one. Since each state of the economy has its own intrinsic character, we cannot foresee the concrete shape of the next generative economy beforehand, as it will have another different intrinsic character. Therefore, evolutionary economists never share the image of time that goes to get the predetermined "essence" of the economy.

In evolutionary economics, the past and the present, and the present and the future, is not a relationship that connects dots like a line. The end of the past contains the beginning of the present, and the end of the present contains the beginning of the future, while the former is preparing the latter. It can be imagined that times overlap with each other, or in other words, different times share the same "space" where changes occur. Thus, evolutionary economics can be said to have a "spatial" sense of time, as opposed to a neoclassical "linear" one.

Based on these observations, G.M.Hodgson, for instance, summarizes the characters of evolutionary economics as follows:

> First, evolutionary economics addresses a world of change. But this change is not merely quantitative or parametric: it involves qualitative changes in technology, organizations and the structure of the economy.… Second, an important feature of economic change is the generation of novelty.… Third, evolutionary economists stress the complexity of economic systems. Complexity involves non-linear and potentially chaotic interactions, further limiting predictability.… Fourth, human agents have limited cognitive capacities. Finally, complex phenomena can emerge through self-organization or piecemeal iteration as well as through design. (Hodgson(2019),p.111).

Another scholar wrote a similar statement,

> We have discussed its *qualitative* nature; its emphasis on concreteness as against abstractness; its acceptance of enduring actuality, as compared with the progressive desire for change; the illusory simultaneity it imparts to historical happenings as compared with the liberal linear conception of historical development; its attempt to substitute landed property for the individual as the basis of history; and its preference for organic social units rather than the agglomerative units such as "classes" favored by its opponents (italics original).

Although the part after "landed property" does not matter so much to us, Hodgson and the second scholar point out very similar characters. However, the

second passage is not what some evolutionary economist wrote to summarize the character of evolutionary economics. This passage is actually from K. Manheim, who detailed the common elements of *Romantic conservatism* about a hundred years ago (Kecskemeti (1953), p.114). We cannot neglect this curious resemblance between Romantic conservatism and evolutionary economics when we talk about the frame of mind of evolutionary economics.

Romanticism is a type of philosophy that emerged in opposition to the Enlightenment or Rationalism. However, it is misleading to regard Romanticism and Rationalism as two different ways of thinking that came from completely different origins. Romanticism appeared as a group of elements of humanity which are excluded from rationalism (for example, passions, sentiments, imaginations, fantasies, etc.) as they were thought to be incompatible. Romanticism and Rationalism are often regarded as being completely at odds with one another after they were separated, but we should note that they, in fact, have the same root because one was created by being excluded from the other.

This reviewer once discussed that evolutionary economics has some elements in common with Romanticism in their way of thinking (Inoue (1999), chp.8). If there is something related to this book, it is the significance of having a formal theory of evolutionary economics. Romanticism tends to regard rational or formal thinking as being shallow and inessential. As a result, Romanticism is often critical of building formal theories, and tends to have a pessimistic view on how well a formal theory works before any testing. Some Romantic thinkers have been very skeptical about theoretical understanding; The most remarkable case was probably the English historical school; W. J. Ashley, who appears to be the central figure of that school, was inclined to oppose the economic theory in general, and declared that what we can or should grasp is the uniqueness of economic phenomena in each specific place and period. Then, he created the new field of economic research, Economic History, to pursue his own style of economics, which he called "evolutionary economics" (Collini et al. (1983), chp.8).

Today, evolutionary economists are usually not as hostile to such a general understanding. On the contrary, they often try to get a general vision so as to elicit a strong feeling of "this is the Economy!" in the readers. That is the very reason we need a formative theory of evolutionary economics. If we only reject the formal theory when we try to get a general understanding of the economy, our whole economic understanding could be swallowed up by an "unstoppable torrent of imagination" (as a Romantic poet once said), which is almost the heart of Romanticism. We should not forget that the original role of formalized theories is not to profess its (so called) scientific nature, but to restrict our images from taking on a life of their own by pushing them into some kind of pattern. Having too much imagination free from any pattern risks making us believe that we have realized an economy with our unrestrained imagination which includes hopeful expectations.

This book repeatedly stresses the limitations of its theory's scope (i.e., to the pricing and production of producible goods). The priority of a formalized theory is to clearly show what kind of subjects and under what kind of conditions the theory can be applicable. We can only get a consistent understanding of the economy by piling up such inflexible blocks one by one. In that sense, this book must be called a

piece of laborious work that draws a clear line between Romanticism and Evolutionary Economics.

6 The ideological implication of evolutionary economics

Though the next topic goes further away from the immediate theme of this book, it is worth noting that this book introduces a new implication of how capitalism influences human intelligence. Not much has been discussed about this ideological aspect; the suggestion of this book is rather gloomy, but not unimportant.

As we have seen so far, this book accepts the lack of an economic subject's rationality (including bounded rationality, a short-sighted view, and the limited range of execution as the innate limit on human capacity). This book also explores the basic elements that make our economy function under these limited intelligences both in price settings and production decisions. In short, this book derives a certain set of economic conditions that is repeatable when the bounded rationality or limited intelligence of agents are *given*. If the theory presented in this book is true to the principle of the *real* economy, the state of intelligence of economic agents, who repeat everyday activities to continue their lives, has to be intermittently *developed* in the repeated experience, instead of *given* just once. The "micro–macro loop," as this book calls it, cannot be constrained to such literal economic activities as price setting or production decisions. It will inevitably include the character formation of economic agents as well. If so, the limited intelligence of humans will not only be a *given condition,* but will also be what capitalism induces and reinforces for the people living under it. We believe that evolutionary economics should think about this aspect of the "micro–macro loop." Although it may sound somewhat ironic with the name evolutionary economics, the idea of capitalism growing lesser human intelligence will allow some interesting new angles of comparison to develop between neoclassical economics and evolutionary economics.

In this regard, why have neoclassicals been stubbornly defending the image of humans as perfectly rational being to be symbolized by homo-economicus? Is that because they really believe such a creature exists in the real world, or because they have lost the critical mind to doubt the theory presupposition because of the education and disciplines they have taken? We cannot deny them both, especially these days. If students of economics, that are absorbed in model building or taught to do so, are apt to lose such elementary critical attitudes as examining the presupposition by referring to their own experiences, we should face the situation with a more urgent sense of crisis.

However, for the moment, let us put that aside. What we would like to reconsider now is that the idea of rational economic man emerged in the late 18th century or the early 19th century, and from the beginning, it was self-evident that such a being did not exist in the real world. A rational man was an ideal image that a real human being should aim to be. A rational economic man was not an average positive image of real person, but a normative image of a human in modern Enlightenment thinking. Moreover, the central idea of that norm was an independent and autonomous individual who was free from the feudal status system. The more sophisticated and

formalized claims of homo-economicus in the 20th century was just an ideal construction developed by pursuing independency and autonomy to an extreme. In that sense, we should also understand that homo-economicus was a historical being.

In fact, in the modern age, the ways to make a society that is consistent with such an image of humans began to be explored. An ideal society was supposed to primarily consist of rational humans, and in turn make its members more rational. People in a modern society were not just satisfied with their given rational ability and they began to understand that they could live a much better life by developing their rationality on their own. It was a basic condition for the modern society that such individual experiences would not be denied in their real lives; there, we can find the origin of the micro–macro loop.

The market economy was considered to be the most suitable system to satisfy these claims of modern society. It should be managed by rational humans and also could be evolved by its members becoming more rational that is, desiring more information and more intelligence, deciding their behaviors not by tradition or custom but by demand–supply calculation, conducting with a wider and longer sighted view, and so on. The market economy was a system where people could hope to improve their social positions by acquiring those rules of behavior and strengthening their competence. In short, the market economy was expected to be a system that would both presuppose and develop rationality. It can be said that a variety of theories of market economy, including the general equilibrium theory, directly and almost naïvely followed this idea of the modern age.

Therefore, unless modern society abandons that idea of modern age, however much homo-economicus is criticized by the new trend of positive economics like behavioral economics, among others, the market economy will never be completely abandoned. Market theory has been pursued not because it has a positive ability to explain the market mechanism, but because it is suitable for the norm of modern society. Furthermore, if it really captures the true essence of market economies, we could already have grown to be more rational and more intelligent beings by simply submitting ourselves to the flow of the market economy.

Regretfully, however, the real economy turned out to be different to what the theory illustrated. It is this book that offers an alternative theory of the real market economy to be used instead of the general equilibrium theory. The reviewer believes what is argued in this book is correct so far in terms of its positive aspect. It therefore provides a glimpse of a much more serious problems beyond its scope: if the conventional theory did not capture the true nature of the market economy, what kind of system do we really belong to?

This book tells us that the economy works under the bounded ability of people in knowledge, scope, and judgement. It accepts these boundaries just as in the real world. However, is there not the possibility that the real economy (that functions with a limited status of knowledge and intelligence) will demand people to have such a bounded status of intelligence? The economy, which is consistent with bounded rationality, is also consistent with the fact that people's knowledge and intelligence are bounded. In this case, if people try to overcome such a boundary and endeavor to gain more knowledge and intelligence, would it not lead to some inconvenient situation for the economy? Is it not possible that this

economy secretly induces people to bound their own intelligence within a necessary and sufficient range in order to manage their daily life and labor?

In their daily experiences, people rarely face inconveniences if they have enough practical or instrumental knowledge for their business. On the contrary, if they try to spare time and acquire other kinds of knowledge, they may find it to be an obstacle to their business (i.e., the perception that they are wasting time for irrelevant things), or to have a critical view against what they do for living. In this way, businesses tend to bound the scope of workers, a fact that is usually understood as an experiential fact. However, this book offers a new point of view that this tendency may have a theoretical background, and it may be a kind of micro–macro loop of the economy which is sustained by people's bounded rationality.

As a result, although the economy can be stable, if that stability is sustained by the stability of human intelligence itself, or the stagnation of intelligence, the question of the kind of system we have chosen for our life arises. On the basis of the presuppositions that this book offers, we should ask ourselves whether the micro–macro loop could have caused such a negative loop. It seems to be a highly realistic and ideological topic that only evolutionary economists can discuss.

On some level, the striking technological development in the modern age seems to contradict such a gloomy outlook, and this reviewer does not deny that capitalism has been sustained by the strengthening of intelligence from which a lot of technological developments stemmed. However, as many reviewers have noticed, it may also be true that many of those technological developments have been accumulated within areas that capitalism considers "innovation." If we say that such biases may be a sign of new "bounding" of our rationality (not just a *given* bounded rationality), would it sound too pessimistic? Capitalism has itself evolved throughout history to become a more sophisticated system. At the same time though, it seems to have restricted the depth and width of human intelligence more and more. Although this book does not deal with this particular aspect, it offers a few hints to make the problems that hide in our economy more clear. Revealing these problems is only possible through the strict formalization that is done in this book, and, as such, this book goes beyond the scope of usual economic theory books.

Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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